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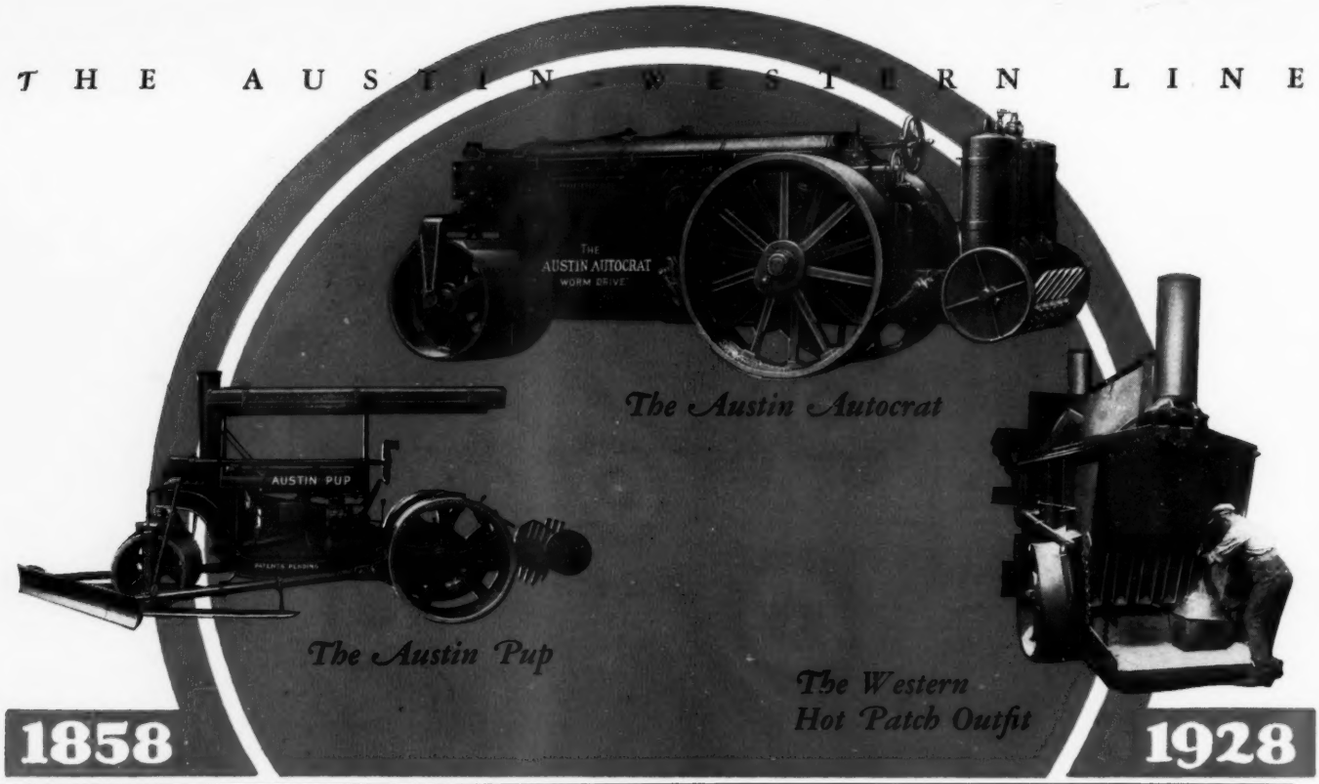

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Surfaces Suitable for Secondary Roads

Conditions requiring such roads, materials suitable, type of surface and cross-section which should be selected for a given road, and construction and maintenance methods that are desirable

By C. N. Conner*

Looking back a number of years, we find high-type pavements have met the needs of thickly populated communities but during this time many rural sections have not been as fortunate. In fact, it was not until after 1920 that appreciable mileages of low-cost improved roads began to appear. These untreated surfaces were not expected to carry heavy traffic. But with improved methods of maintenance, reconstruction, betterments and new construction highway engineers have rapidly extended road service to these rural sections. The results of their efforts have been effective but they have not kept pace with the ever mounting vehicle registration.

There are 23,000,000 motor vehicles in use in the United States, 87% passenger cars, 12.6% trucks and 0.4% busses. The task for the road builder is to give them highways to roll over. Our total road mileage is about 3,000,000, of which 85 per cent are unsurfaced, 10 per cent are a low-type surfacing such as untreated sand-clay, gravel and stone; 4 per cent are an intermediate type and less than 2 per cent are high type surfaces. These figures indicate that a high percentage of our roads will need some type of surfacing or surface treatment within the next few years, if the now isolated sections are to have service.

About 1920, when automobile registration began rapidly to increase, it was found that funds and time were lacking to give road service over a sufficient mileage to satisfy the public. The construction of high-type roads required more time, more money and more detours than many portions of the country could divert to road building. There were conditions where the present and probable future traffic did not warrant so great an expenditure. By some engineers it was considered more important to connect objectives and build feeder roads to trunk lines with a roadway capable of taking traffic up to 1,500 vehicles per day. And so this new era of low-cost road construction began. Today we find on every hand a growing interest in the development of surfaces suitable for secondary roads. One prominent state highway engineer recently said: "With plenty of funds it is easy for an engineer to design and build a pavement of excellent quality; but to take the same funds and bring relief to a large area that would have to wait many years for scientifically designed and well built pavements, in the meantime paying a mud tax much greater than the cost of pavements, is to my mind a much greater accomplishment."

There are engineers, however who are doing this very thing and in spite of the obviously easy course of building high-price pavements, with their low maintenance cost, they are building secondary types of surfacing which are suitable for their local requirements of traffic and service. This kind of

* Chief engineer, American Road Builders Association.

GRAVEL ROAD IN VIRGINIA SURFACE TREATED WITH BITUMEN AND CLEAN, HARD AGGREGATES

road building demands knowledge, judgment and courage.

Just what has been accomplished and how it has been done must be of interest to every highway builder who realizes the possibilities for increasing highway service. Some questions on this subject naturally appear at once.

1. What conditions require the construction of secondary surfaces?
2. What materials are suitable?
3. What type of surface shall be selected?
4. What typical cross sections shall be selected?
5. What are the construction methods?
6. What are the maintenance methods?

1. WHAT CONDITIONS REQUIRE THE CONSTRUCTION OF SECONDARY SURFACES?

Frequently it is a lack of funds to build high-type surfaces between objectives or as feeder roads. Again, it may be the lack of time to build high-type surfaces to satisfy the immediate necessity for highway transport. Transport surveys as conducted in Maine, Connecticut, Vermont, Ohio and elsewhere have been enlightening in indicating the character, volume and weight of present traffic. These studies are used for predicting future transport conditions for these states. With this estimate of future transport conditions, an intelligent and economic selection of type of surfacing may be made.

By the aid of conclusions drawn from these transport surveys it is expected that approximate estimates may be made for similar conditions in other states without an extensive field survey in such states.

Light trucks and automobiles, if equipped with pneumatic tires and not exceeding a daily average of 1,000, are now being carried on surfaces which cost less than $10,000 per mile for an 18-foot width. Traffic up to 1,500 does not appear excessive for many of these types and 2,000 vehicles per day is not unusual.

The quality of service rendered is an important factor, which may be determined by measuring the length of time required to travel between objectives in safety and comfort. The regularity of the actual surface may be determined by several types of instruments, such as the roughometer, bumpometer and vialog. The cost of road service may be calculated as the cost per vehicle-mile for construction, maintenance, and interest. If the quality of service is satisfactory, the cost of vehicle operation, although worthy of consideration, does not greatly interest the average motorist.

Nearly all secondary surfaces have a salvage value as a base for future surface courses or surface treatments or as a subgrade treatment for pavements. Just what this value may be is only recently receiving proper consideration. I know of one investigation which reported fewer cracks in concrete roads built on well compacted sand-clay surfaces than on raw subgrades; another which has reduced the depth of pavements when built on such surfaces; another which has declared a policy of surfacing with secondary surfaces in order to allow fills and new grading to become consolidated before building high-type surfaces.

2. WHAT MATERIALS ARE SUITABLE

Without doubt gravel is the most universally used, because of its wide distribution throughout the country; 52.2% of all surfaced highways are gravel. Sand-clays represent 13.6% and water-bound macadams 12.9%. Surface-treated macadams and gravels represent 5.7%, while all other types are 15.6%. These were 1924 figures.

Availability of local materials and short hauls govern the use of suitable materials. In Florida for example, lime rock is used extensively for base; sand-clays are used in the southern states generally; chert in Alabama and Georgia; shale in West Virginia and Pennsylvania; caliche in Arizona, New Mexico and Texas. Gravel and crushed stone are found in nearly every state. For surface treatment, calcium chloride is used extensively in Michigan and Vermont and also in Maine, Connecticut and New York.

Bitumens are becoming more and more popular for surface treatments of gravel, sand-clay, stone, and lime rock. They include asphalts and tars that are applied to these surfaces from a power distributor. Applications may be hot or cold, and a variety of cover material is used ranging from coarse sand to crushed stone in suitable sizes. Bitumens are also used for premixed surfaces which are applied hot or cold. In fact, the flexibility and adaptability of bitumens to construction with secondary types of surfaces indicates that they will be used in the future even more than in the past. In California and along the West Coast the use of "fuel oils" of high asphaltic content gives promise of economical surfaces by using local aggregates with local bitumens.

Aside from the materials mentioned, few others now qualify as suitable without costing more than $15,000 per mile for original surface and its surface treatment. Natural rock asphalts in Texas, however, are competing in service and cost with other bituminous surface treatments.

3. WHAT TYPE OF SURFACE SHALL BE SELECTED?

Selection of type is principally affected by the availability of local materials. The untreated types of surfaces suitable for 300 to 600 vehicles per day include traffic-bound or roller-bound surfaces of sand-clay, disintegrated granite, chert, shale, gravel, slag, stone, lime rock, marl, caliche, volcanic cinders and mine tailings. For traffic of 600 to 1,000 vehicles per day, calcium chloride on gravel does well in states which have average or high humidity and rainfall. For traffic of 600 to 1,500 vehicles per day bituminous surface treatments on substantial bases of sand-clay, chert, shale, gravel, slag, stone, lime rock and volcanic cinders are giving excellent service. For traffic averaging 1,500 or more vehicles per day with some heavy trucks, premixed bituminous surfaces are used with a thickness of 1½ to 3 inches. The bases usually selected for these types are macadam, lime rock and gravel.

4. WHAT TYPICAL CROSS-SECTION SHALL BE USED?

There are three principal types of cross-section: the feather edge, the trench, and the "spill over" which is a combination of the trench and feather edge sections. All of these types are used for gravel.

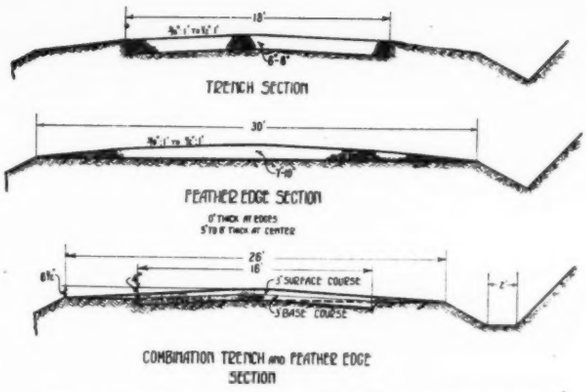

FIG. 1—TYPICAL CROSS-SECTION USED FOR UNTREATED SURFACES

Used later as bases for bituminous surface treatments, or as a subgrade treatment for pavement types

The feather edge is used for sand-clay, gravel and nearly all traffic-bound types. The trench section is used for macadams, chert, lime rock gravel, and nearly all roller-bound types. The "spill over" section is used principally for gravel, but it could be used for nearly any untreated surface which carries a loose surface mulch of material. The bituminous surface treatments are usually uniform in thickness.

Various methods of edge strengthening have been tried out. They include headers of stone, bituminous macadam, bituminous concrete, portland cement concrete, timber and thickened edge designs. Designs using a wider base than top are growing in favor. It has been found that maintenance costs are less for wide surface treatments than for narrow ones. Some states do not place surface treatments in less than 19 or 20-foot widths.

The thickness of bases for secondary roads averages about 6 inches. The bituminous surface treatments of the dual type vary from ½ to 1 inch in depth; the mixed-in-place and the premixed types, from 1½ to 3 inches.

5. WHAT ARE THE CONSTRUCTION METHODS.

For quick service and a small initial investment, the traffic-bound method is simple. By this method stone, slag, gravel or sand-clay are applied periodically to a road surface until a compacted depth of 5 or 6 inches is built up under traffic. Sand-clays, gravels and materials which may be bonded without watering or rolling may be built in one course if the total depth is not over 9 or 10 inches for sand-clays and clay-gravel or about 6 inches for materials which do not bond as readily.

Macadams and stone bases which require rolling or watering are seldom laid more than 4 or 5 inches in depth for each course. But lime rock as built in Florida is laid in one course to a compacted depth of 8 inches with good results.

Calcium chloride is applied to road surfaces in flake or powder from a lime distributor. For surface treatments with bitumen, power distributors are fast replacing hand-pouring methods. Bituminous surface treatments are usually one of two types —the penetration or surface application method, and the mixed-in-place method.

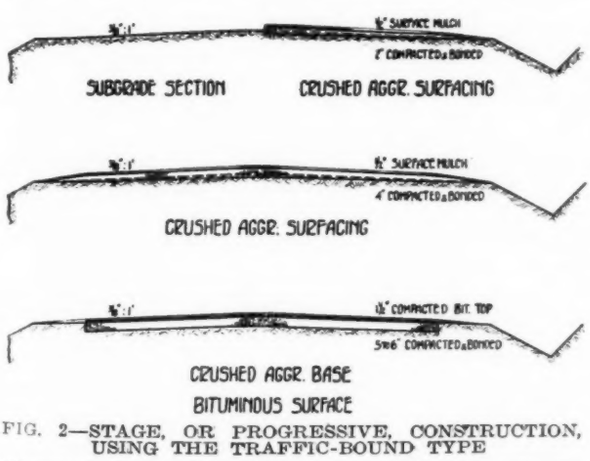

FIG. 2—STAGE, OR PROGRESSIVE, CONSTRUCTION, USING THE TRAFFIC-BOUND TYPE

Materials (stone, slag, gravel) are added periodically until a dense, well compacted surface results. This is treated with bitumen with excellent results

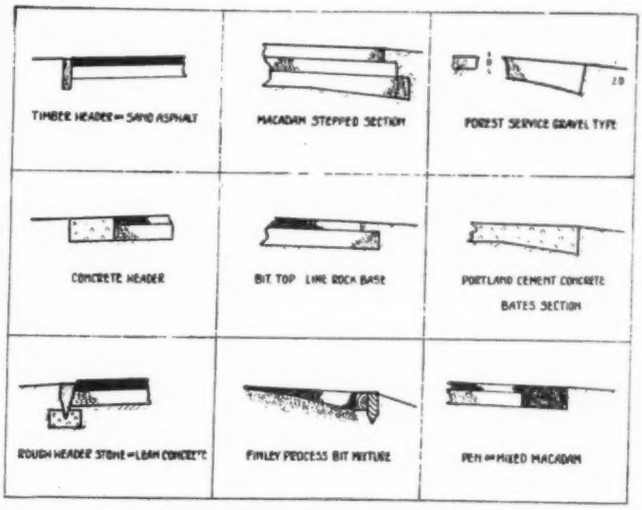

FIG. 3—EDGE STRENGTHENING

All types of surfacing less than 18 or 20 feet wide tend to break down at the edges. All of these methods are more or less effective. Wide surfaces (from out to out of shoulder) show less breakage at edges than narrow sections

The Penetration Method. This method is in common usage for all types of surface treatment work, that is, surface treatments which include one or more applications of bitumen and one or more spreadings of cover material. It is designed for use on well-compacted surfaces which do not have loose material at or near their surface.

The Mixed-in-Place method is new, with few exceptions, within three or four years. Its purpose is to consolidate the existing loose or unstable aggregates by mixing them on the road with bitumen. Surfaces containing such aggregates as crushed or screened gravel, stone and sand-clay or sand-loam have been thus improved.

Premixed methods using hot mixtures are well known. The hot mixed macadam as used in Canada differs but little from black base, two-course construction. The premixed surfaces which are laid cold offer few construction difficulties and slightly reduce the cost of plant operation below that required for hot mixes.

6. WHAT ARE THE MAINTENANCE METHODS.

There are three principal methods of keeping an untreated road surface serviceable.

1. Addition of new materials which are similar to those in the existing surface.
2. Blading and dragging.
3. Patching.

All three methods, including scarifying, may be necessary on any one type of road.

The addition of new materials is common practice, and a necessity on gravel and sand-clay roads. This is done at varying intervals of from one to four years.

Light blading or dragging from two to six times a week, regardless of weather, is the practice in states which have good gravel surfaces.

Surfaces treated with calcium chloride are maintained in much the same manner as untreated surfaces. But less surfacing material is required annually and blading can be done more satisfactorily on the moist treated surfaces.

The two types of bituminous surface treatments are maintained by retreatments and patching. Scarifying and reshaping, followed by light retreatment with bitumen and cover, are not unusual. If the surface is too rich in bitumen and tends to shove under traffic, it may be improved by blading or planing with a heavy drag. Sometimes the addition of coarse stone chips rolled into the surface will correct the condition.

It costs more to maintain secondary-type surfaces than high-type surfaces and the cost of maintenance increases with the volume of traffic. Secondary surfaces should not be built unless perpetual and intelligent maintenance are to follow. During critical seasons of the year, such as when frost is leaving the ground, it may become necessary to reduce the volume and weight of traffic. But in spite of these conditions, secondary roads are now necessary and will be so for many years to come.

Within the past few years thousands of miles have been built and the public is traveling over them in comfort and safety and at high rates of speed. These surfaces are considered an economical investment by those responsible for their construction.

FIG. 5—CALICHE SURFACING IN NEW MEXICO

Caliche contains carbonate of lime, sand, gravel and small quantities of clay. Obtained from local pits at or near ground surface

FIG. 6—THE DISTRIBUTOR, TRUCK AND SWEEPER ARE INDISPENSABLE FOR SURFACING LONG MILEAGES AT LOW COST. NORTH CAROLINA

FIG. 4—ROADSIDE SHALE PIT IN WEST VIRGINIA

Road Work in Maury County, Tenn.

By F. B. Wilkes*

Road conditions in Maury County, Tennessee, are typical of those found in many counties throughout Tennessee and Kentucky, where rolling to hilly land is occupied by agricultural communities. The population is about 35,000, seventy-five percent of which live on farms. There are excellent elementary schools located in the various communities, and high schools situated so as to be accessible to every station; but access to these demands year-round passable roads in every section, as do also rural routes, and mail trucks running on regular routes.

There are approximately one thousand miles of roads in the county, 75 miles of which are state highways, 100 miles are main or special highways, and 125 miles are district roads. These roads are not laid out in any systematic manner but follow property lines, creeks, or the whims of influential citizens, and it is therefore necessary to make many

*Superintendent of Roads, Maury County, Tennessee.

changes and sometimes entirely relocate a road. They are all too narrow, the old right-of-way ranging from 18 to 24 feet, frequently lined with high banks grown up in bushes and trees.

As rapidly as possible we are widening the narrow roads, acquiring 30 to 36 feet right-of-way, which permits building a 24 to 30-foot road with ditches, which is ample for present traffic conditions. The cost of actual widening is frequently considerable because of the bushes and trees to be removed and the banks alongside to be cut down.

Most of our work is being done in those communities which offer the greatest amount of cooperation, and is confined to work which the farmers are not equipped to do, such as heavy grading, building culverts, blasting rock, etc.

Metaling the cross roads is left almost entirely to the farmers, although we load the wagons for them. Some communities have raised money to pay for grading where the county had no funds available, and in several cases they have paid operating cost of trucks to place metal on the roads.

In the hilly sections the culvert problem is a serious one. We are putting in metal and concrete culverts wherever possible, and have already succeeded in considerably reducing repair bills by these means. For the past three or four years we have made it a practice to replace every culvert which was in bad condition, even though it meant sacrifices in other lines of work.

The soil varies from a rich silt loom to gravelly clay. There is abundance of gravel in the various creeks that empty into Duck river, the main stream draining the country; also chert beds in the northwestern section of the county sufficient for all future needs. There are outcroppings of limestone in all of the county, particularly in the east, where it is a serious obstacle to the building of roads.

In heavy grading, we first pull all bushes and small trees up to 8 inches in diameter, using tractors, and convicts clear all large trees, small brush, weeds, etc., and drill and remove rock. The graders then cut the banks and pull the dirt into the road. Scoops are used to side fill, make cuts, fill up to culverts and bridges or for other purposes. The road bed is then graded and shaped to a width of 24 feet. Failure to bring cuts and fills to a reasonable grade has been disastrous in several counties because big rains have caused damage with consequent demand for expenditures of money for repairs which in the long run cost more than adequate construction work would have caused in the first place. During the heavy rains in 1926-1927, the well graded roads in this county came through with relatively small damage, while those not graded were damaged badly.

For this grading work were used two 5-ton and one 2-ton crawler type tractors, with suitable grader for each tractor; two fresno scapers; four Baker-Maney scrapers; plows, cables, etc., and two air drills and an assortment of small tools. For hauling equipment we have three 3½-ton dump trucks an two 1-ton dump trucks, with which we can place metal on the road for considerably less cost than with teams. Tractors and scrapers are used to get metal out of creeks where trucks can not operate, and during low water in summer we frequently store gravel at a point accessible to trucks in winter, for use in emergencies or for general use. This frequently saves us long hauls on metal.

Maintenance is an increasingly big problem. While most of it is confined to roads which have been widened and improved, we are on the lookout for opportunities to widen and improve existing conditions. Our maintenance equipment consists of two one-man power graders, one 10-20 wheel tractor pulling a 6-foot grader or a 4-blade maintainer, having a cutting width of 12 feet, and a two-ton crawler tractor pulling a 7-foot grader. As far as possible we use all this equipment on the same job, thereby saving transportation cost on the operators.

With the 4-blade maintainer we make one round, pulling the material to the center of the road and then pushing it off with the maintainer or with the one-man grader. This double working lessens the tendency to high crown as well as being very beneficial to the road. The crawler tractor with 7-foot blade is used for ditching and any heavy work that may be necessary. We can finish five to ten miles of road per day with these graders, as they travel at a speed of three to five miles per hour.

The operators leave the machines wherever night finds them and all go to work together in a car or small truck the next morning, bringing their gas, oil etc. for the days run. All gas and oil is bought at wholesale prices, and distributed to each operator from the workhouse camp and a ticket made for each. These tickets are checked at intervals.

Ordinary repairs on the equipment are made in the field by the operator, but sometimes the machines have to be brought to a public garage or machine shop. We hope in time to have a shop of our own for doing this work. There is, however, an advantage in the operator doing his own repair work, as he is thus more prompt to detect trouble and prevent breakage.

Most of our operators started with the present organization, are well satisfied, and take a great deal of pride in their work. There is therefore little labor turnover. Equipment suitable for the work in hand is important, but good operators are more so, as no machine is better than its operator.

In planning improvements, effort is made to provide for traffic five, ten or twenty-five years from now, so that grade and drainage constructed today will be adequate for a hard surface road at that time. Cross roads accommodating few families can get along with less width and shorter culverts, but frequently these roads are little travelled on account of an unbridged creek or bad hill, and when this condition has been remedied the travel may increase many fold.

Before purchasing machinery, we investigate conditions in similar counties, and obtain the benefit of their experience, and consider carefully in order that machinery purchased today may not become obsolete in a year or two. The equipment mentioned above is very satisfactory and is doing splendid work, but we could use double the amount of maintenance equipment to great advantage; also a 10-ton crawler tractor with a 12-foot blade. This large tractor would be very useful in clearing rights-of-way, as it could pull much larger trees than the five ton, also the grader would cut away many small roots and stumps that otherwise have to be grubbed out.

Manitoba Highways

More than half the arterial highways under government control. 1,400 miles of gravel road under maintenance.

By A. E. McHugh*

In the Province of Manitoba the need for main roads was recognized at an early date. This is evidenced by an Act passed by the Legislature in 1871 designating as "Great Highways" what are now known as the Trans-Canada highway from Winnipeg to Saskatchewan boundary, the Lord Selkirk highway, and Winnipeg-Beach highway from Lake Winnipeg to Emerson, and the Dawson Trail from Winnipeg to the Lake of the Woods.

A long interval then ensued during which the municipal authorities were actively engaged on road building within their confines and, as the Province developed, the need for through roads became increasingly greater. In 1912, in obedience to the demands of the Province and realizing the importance of road building, the government enacted the first assisting statute which was known as The Highways Improvement Act of 1912, under which the government assisted municipalities in Provincial highway construction to two-thirds of the cost. This act effected a fair trial of road building in the Province and was the means of indicating the needs and ambitions of the municipal bodies. In order to more fully meet the situation caused by the desire for extensive road building, the Good Roads Act was passed in 1914.

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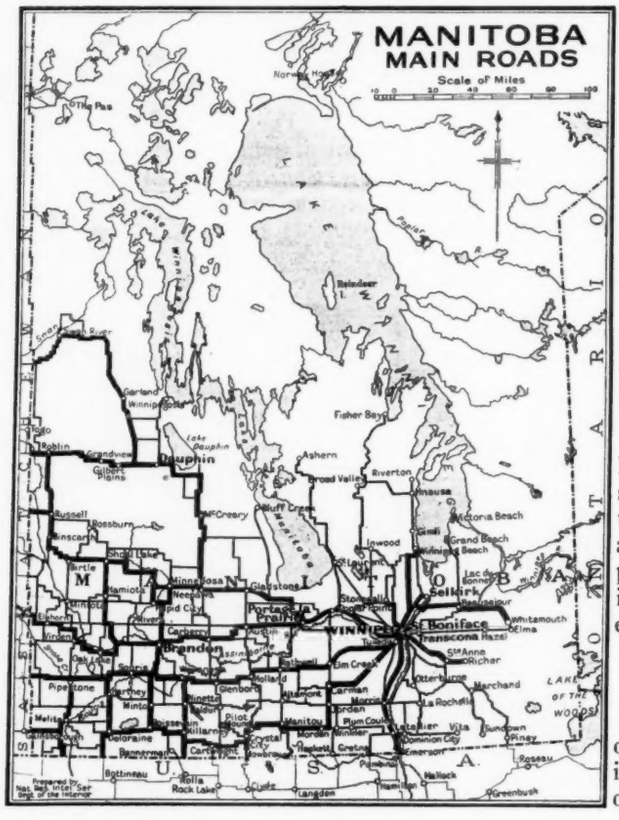


The provisions of the Good Roads Act are wide and under its aegis the road question in Manitoba appears to have found its solution. It has been the medium of co-ordinating municipal systems with Provincial highway requirements, with the result that the map of our highway system shows that a comprehensive highway system exists which efficiently serves the municipalities through which they pass, and at the same time, and with equal facility, meets the requirements of touring and through traffic.

The highway policy adopted by the Province of Manitoba in 1925 has been prosecuted on an ascending scale since that year. The objective is the gradual absorption of 1,600 miles of arterial highways which will serve all important points of the Province, as well as affording connecting links with the Saskatchewan and Ontario highways and the States of Minnesota and North Dakota.

The process of absorption is proceeding apace and at the present time 835.6 miles have been taken under entire government control for construction, surfacing and maintenance.

The great proportion of the mileage assumed by the Province is constructed to good roads standard and the government is therefore chiefly concerned with maintenance and surfacing.

The objective at present, in the improvement of this Provincial system, is gravel construction. With the long distances to be covered and the vast areas to be served, viewed with the population of the Province, this type of construction must in general suffice, and will, no doubt, be satisfactory for some years to come.

The maintenance operations contemplated for 1928 cover approximately 1,400 miles, a great portion of which will be maintained by horse maintainers on an average patrol of 8 miles. Motor patrols are increasingly in use near the larger centres of population and "caterpillar" tractors are in general use for graveling. Some idea of the development of maintenance in the Province may be gained by the fact that in 1923 the amount spent was $30,000 and the appropriation for the year 1928 is $650,000.

All roads are built to standard grade. The prevailing type is earth road with gravel surface. The gravel deposits are large, but not generally contiguous to the highways, and gravel surfacing is therefore a heavy item in expenditure.

The progress made by Manitoba in its road establishment has been gradual and steady, and in response to the requirements of the different parts of the Province. Commensurate with the population and financial ability, the work accomplished has placed our Province in a strong position for farming, marketing, tourist development and industrial expansion.

Paving Brick Standards

The U. S. Department of Commerce Committee on Simplification of Variety and Standards for Paving Brick, at its meeting this spring, approved without change the same five recognized varieties and

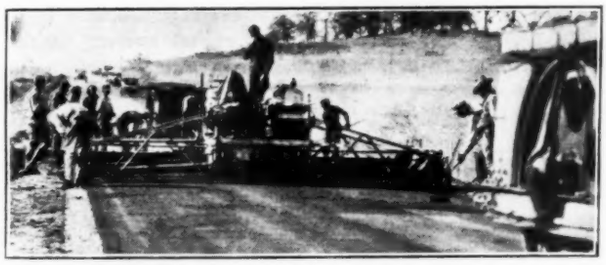
sizes of vitrified paving brick as last year. These are all 8½ inches long; the three sizes of plain wire-cut brick are all 4 inches high, while the repressed brick and wire-cut brick are 3½; and each of the latter two has a width of 4 inches, and the three plain wire-cut sizes are 2½, 3 and 3½ inches wide respectively. George F. Schleisinger, State Director of Highways, Ohio, and representing the American Association of State Highway officials, was elected chairman of the committee to fill the vacancy caused by the resignation of E. J. Mehren.

Finishing Machine on Asphalt Pavement

Among the recent improvements described in the article published in our March issue dealing with developments of asphalt pavements during 1927, was the use of finishing machines for spreading and leveling off asphalt wearing surface, instead of shovels as herefore.

Among the contractors who have recently used machines of this kind is the H. L. Cannady Company of Tulsa, Oklahoma. The machine he used was not one made specially for this purpose but was a Lakewood Type C screed finishing machine which he had used to screed and tamp the concrete base on which the asphalt top was to be placed. The tamper was not used for the asphalt, the screed member alone being employed to spread, compress and surface the top.

The base had been made with side curbs, as is



USING FINISHING MACHINE ON ASPHALT SURFACE

common in preparing for asphalt surfacing, and the machine travelled on these curbs. In the morning, before starting work, the screed was given a preliminary heating with a kerosene torch. After this the heat of the asphalt material kept it hot enough to prevent sticking while it was operating.

The contractor reports that the use of this machine eliminated the necessity for expert hand rakers and reduced materially the number of men required for spreading; also it increased the daily production by more than 50%.

More important to cities and road officials is the more uniform and smoother riding surface which is ordinarily obtained with these machines as compared with hand shovelling and spreading.

First Traffic Subway in the Far East

Tokyo, Japan, has begun the operation of what is believed to be the first subway in the Far East, which was opened to public travel at the end of December, 1927. It connects two thickly populated sections of the city. Construction of it was begun by a private company in September, 1925. The section now in operation is about a mile and a half long, with two intermediate stations. Nine other sections are contemplated by the municipality, extending into and across the entire city.

The subway is of rectangular section, was built in open cut, and is 12 feet high above the rails and 24 feet wide, increasing to 36 feet at the stations. The general construction and the stations are quite similar to those in New York City, including the spaces for advertising on the walls of the stations and the turnstiles of the coin-in-the-slot type. The all-steel cars have longtitudinal seats, and metal handloops overhead for the strap hangers, together with iron posts in the aisle. The motors and control equipment were made by the General Electric Company but the lighting equipment and accessories and transformers by Japanese manufacturers.

Road Grading with Power Shovels

Brief discussion of factors affecting the operating cycle of a shovel. Change in management methods may double output

The Division of Management of the Bureau of Public Roads, of which T. Warren Allen is chief, has begun publishing in its official journal, "Public Roads," a series of reports on observations made on going projects relative to power shovel operation in highway grading. The first of these articles, reported by Chief Allen and Andrew P. Anderson, associate highway engineer, furnishes an outline of the more important facts developed in studies and discussions of factors affecting the operating cycle of the shovel.

These studies show rather conclusively that a high degree of efficiency is possible of attainment, and that in general the cause of the low production encountered on many projects is due to conditions over which the management has more or less definite control and which are therefore, to some extent, remediable.

"On this work the shovel is the primary producer. All production is dependent upon it. An inferior shovel or operator is a certain guarantee that production costs will be high. The shovel should be sturdy, powerful, dependable, fast, and easily operated. But no matter how good the shovel, a high grade of skill, intelligence and endurance is required on the part of the operator in order to secure consistently a high rate of production."

"The ideal operator is a man gifted with quick reaction, a true eye, good judgment, great endurance, and a high degree of skill and experience. He should know the possibilities as well as the limitations of the shovel and be able to maintain it in first class condition.

"But it is not enough simply to secure a good operator. Except where casting is involved, the operator can dig no more material than the available equipment can haul, and he can only dig when hauling units are actually in place for loading. If the

supply of wagons or trucks is inadequate to handle full shovel production, or if their operation is such as to interfere with the steady, methodical operation of the shovel, the fault lies with the management.

Observation of a large number of projects indicates that "there are few jobs on which a material increase in output can not be obtained without a corresponding increase of cost. In some cases it has been found possible to increase the output as much as 100 per cent. by a change in management methods.

"Under favorable conditions, a good operator can attain a rate of loading of four dipper loads per minute for intermittent periods, and three dipper loads or more per minute as a continuous rate. By whatever amount the contractor fails to attain this rate under favorable conditions, he is failing to attain the maximum possible efficiency."

The report presents in considerable detail, by tables and diagrams as well as by text, the facts observed and conclusions reached in this study. The latter may be briefed as follows:

Efficiency of production can not exceed the efficiency of the shovel operator. To change an operator making a load every 18 seconds for one who takes 20 seconds reduces the output 10 per cent. This can easily amount to $20 to $25 a day in lost profits.

The difference in time required to make a 90° swing in loading and to make a 180° swing may reduce the output by as much as 25 per cent.

A mass diagram is essential in planning hauling equipment and estimating on a job. With such a diagram, and knowing the time constants of operation, it is possible to determine the most efficient outfit and how long it should take to do the work.

Determination of proper team supply greatly affects profits. One job is estimated to cost $15,440 with an 8-team outfit which can be done for $14,555 with an 11-team outfit.

It is often advantageous to sublet short-haul work or to do it with wheelers or fresnoes when conditions result in a surplus of teams at the shovel.

Work should be continued under adverse conditions when it is possible to earn more than the difference between the costs which accrue while working and those which accrue while idling.

It has been found that the diversity of kinds and sizes of trucks has produced varied results in meeting the specialized requirements of use with a power shovel.

Using trucks on a short haul, it has sometimes been found possible to double the output by backing them to the dump rather than making a turn at the dump and another at the shovel.

Roadway conditions play an important part in truck operation. Pneumatic tires, particularly those of the dual type, are preferable.

Crawler-type tractors drawing large dump wagons have been found adapted to conditions commonly found on power-shovel jobs. The number of trains used must agree closely with economical requirements. As an example, the use of one 2-wagon train on a particular job requiring two such trains would have increased the cost of the job nearly $7,200, while the use of three trains would have increased it $1,250.

Contractors' Obligation to the Construction Industry

"The Associated General Contractors recognizes that what is fair and most beneficial to the public or to other elements of business is likewise fair and beneficial to responsible contractors. It is therefore endeavoring to clean house in the construction industry so that responsible concerns, irrespective of their size, may secure the tangible benefits to be derived from fair practices, good management, and faithful performance of contract."

This statement was made by S. M. Williams, manager Engineering Construction Division of the Associated General Contractors, at the end of an address entitled "Our Obligations to the Construction Industry," delivered before a meeting of the New York State Highway Chapter of the Association.

He told the contractors that he believed the principal difficulties in the construction industry are largely due to a failure of the contractors to realize and meet their own individual obligations to the industry.

Mr. Williams reviewed the criticisms of public officials, bankers, surety companies, and others which have been so common during the past two or three years. Concerning the public officials, he believed that the majority of them are anxious to cooperate in the elimination of the irresponsibility in the construction industry, realizing that it is not to the interest of the public to award contracts to irresponsible or inexperienced bidders. They are not, however, willing to carry the burden of educating the public when the construction industry itself is constantly encouraging and contributing to this irresponsibility.

As to the surety companies, these have recently received more criticism perhaps than any other class, and yet he finds that comparatively few of these companies have made any change in their bond writing practices.

Bankers have been very liberal in extending credit to contractors, but early in 1927 the American Bankers Association, through the Clearing House Bureau, approved and recommended to the Clearing House members throughout the United States the use of the standard questionnaire prepared by a joint conference on construction practices, which questionnaire is now being used by many bankers throughout the country.

Not so much has been said about the responsibility of equipment manufacturers for present conditions. Mr. Williams said: "The manufacturers and distributors of equipment have been as guilty in contributing to the present unsatisfactory conditions in the construction industry as any other element, including the surety companies. In many cases the equipment manufacturers have injected the irresponsible or inexperienced contractor into the construction industry simply for the opportunity of

making a sale, and frequently it was to the detriment of a former customer of the manufacturer.

"The motor truck manufacturers and distributors have been responsible for injecting into the industry the irresponsible hauler, who has become a serious menace to the responsible and honest contractor, who realizes that if the sub-contract hauler on a road contract is to be satisfactory to the general contractor he must be reliable and insure dependable transportation, which means that his profit must be more than sufficient to cover overhead, interest, depreciation, maintenance and living expenses. In all sections of the country the motor truck industry has been feeding into the construction industry the irresponsible and inexperienced hauler as rapidly as they could induce the individual to part with what little money he had, and to enter into note obligations secured by some sort of sales security for the balance. In many cases the note obligations were for the full amount as no cash was received. The individual was allured with the wonderful possibilities in road hauling as a possible business. In many cases, trucks have been sold upon the basis of securing a hauling contract for the hauler. The trucks were sold, the hauling contract secured, and the haulers with new trucks were deliberately placed on the work at a price which the salesman knew (or should have known) would not earn for any hauler sufficient money for him to meet his note obligations on the truck investment which the seller of the motor truck had induced the hauler to assume.

"In Chicago, the motor truck industry recognized these conditions and early in 1927 organized the distributors into an association, with the result that a large number of motor vehicles were taken out of the hands of men who were attempting to earn an honest living upon the basis of inadequate hauling revenue." Within a year the association had repossessed 606 trucks and automobiles, 536 trucks, and 358 trucks hauling in connection with building or engineering construction. An analysis of 423 of the motor trucks repossessed showed that 103 were sold with no payments, 104 with less than 10% cash, 82 with between 10 and 20%, and only 35 with over 20% cash. The total amount of the sales was $1,143,704 and only about 8% cash was received. There was charged off to bad debts $380,944, or a little over 36% of the original credit extended.

Ridiculous as it may seem, there are many contractors buying equipment who are not interested in the reputation of the equipment but are primarily interested in how long a period the equipment manufacturers or distributors will spread the payment or in other words, how long will the equipment manufacturers and distributors be willing to invest their money in this contractor's business.

The material manufacturers also came in for a few remarks, Mr. Williams stating that they "almost equalled the surety companies and equipment manufacturers in their contribution to the unsatisfactory conditions in the construction industry." He especially scored them for abuses of the lien laws, which "have frequently placed them beyond any consideration of the responsibility of the contractor. They have frequently acknowledged that their basis for extension of credit was solely the lien law. I predict," said he, "the lien law abuses will in time react in the attitude of the public against lien law protection for material and equipment furnished on construction contracts. It will also react in the minds of many responsible material dealers because the lien law has, in itself, increased undesirable competition in the construction material business.

"It is time that the manufacturers of equipment and materials entering into construction work should give serious consideration to standard terms insuring intelligent credit extensions and sane sale policies, which should not be based upon sales securities and lien law protection. Sales securities and lien laws should be considered only as an emergency for protection, if considered at all. I believe however, that they encourage careless and indifferent sales and credit supervision."

The irresponsible contractor has received considerable attention during the past few years, but Mr. Williams turns his attention to the *responsible* contractor, who, he said, "is a different proposition and in many cases is just as guilty of bad practices, thereby becoming as serious an offender, as the surety company, the bankers, and the equipment and material manufacturers." He quotes a prominent state highway official as having said: "Why fuss at public officials about the low prices at which the public work may be let, when the *most responsible* men in the contracting business *repeatedly* establish such prices? Either the prices are right and the lament is wholesale propaganda, or the contracting industry needs to clean its own house." A construction publication is quoted as saying: "When an experienced contractor knowingly and purposely bids a job at a no-profit price, with deliberate intention of taking a profit out of the job if he can, by fair means or foul, he is a barnacle on the profession and is not entitled to the esteem of those of his competitors who are striving to make the profession one of skill, integrity and responsibility."

Mr. Williams stated that he had "heard contractors admit that they were bidding contracts at cost with the intention of beating the profit out of the sub-contractors. Such a policy" said he "is not giving the sub-contractor the same square deal which the contractor expects and demands for himself. The contractor who is not fair and honest with his sub-contractor is not entitled to respect and consideration of his associates in the construction industry."

Finally he said: "When the general contractor realizes that every man with whom he transacts business is entitled to the same square deal which he himself expects and demands; when the responsible contractor realizes that a demand upon the surety companies to write bonds without giving definite and accurate information regarding the condition of his business is not fair; when the responsible contractor realizes the demand upon equipment manufacturers for unusually long credit terms, and that a continuance of buying from material and equipment manufacturers who base their credit extensions upon sales securities and lien law protection is assisting in the encouragement and injection of irresponsibility into the industry; and when he discontinues such demands, then and then only has

the contractor the right to expect relief from the condition about which he complains.

"It is strongly suggested that boycotting by good contractors of all other factors allied with construction who are unduly encouraging unfair competition by the ignorant and incompetent, would go a long way in eliminating the present unsatisfactory conditions."

Highway Damage in the Flood District

The American Road Builders' Association has called attention to the fact that most of the roads damaged by the Mississippi flood were unimproved highways, while the improved highways withstood the water wthout serious damage.

"Roads without improvement," says the association, "were in many cases virtually wiped out, causing an expensive delay in traffic and curtailing the movement of necessary food and shelter supplies. Bridges were completely destroyed in sections where the foundations were not constructed to withstand the swift moving waters." The total damage to highways and bridges is set at $3,949,900 by the survey which has now been practically completed.

The Association urges the immediate construction of an adequate highway system designed to withstand the maximum flood waters, in those sections subject to overflow. "The existence of these roads will facilitate the salvage of personal property, protect human life and permit speedy reconstruction of damaged areas."

Sedimentation at Separate Sludge Digestion Plants

Comparison of operation results of sedimentation units at five plants. Similarity in removal of settleable solids but not of suspended solids. Trade wastes in sewage partly responsible for variations in the latter.

Second of this series of articles.

By Anthony J. Fischer[2]

The purpose of this paper is to compare and discuss results on sedimentation obtained at separate sludge digestion plants at Hartford, Kiel and Antigo, Wis.; Ridgewood, N. J., and Sioux Falls, S. D.

The sedimentation tanks at the plants visited are all square in plan with floor sloping 1" to 1¾" per foot, and equipped with Dorr clarifier mechanisms. They differ chiefly in the design of the influent channel and in the tank depth. The mechanisms are all of the type having two short and two extension arms supported from a central shaft which rotates continuously at a speed of about 1/7th to 1/12th revolution per minute and sweep the settled sludge to a central cone from which it is pumped to separate digestion tanks.

Tests run included flow measurements and determinations of settleable, suspended and dissolved solids; biochemical oxygen demand, pH values, acidity, alkalinity, ammonia, nitrites and nitrates on both influent and effluent.

Samples were taken hourly and composited in proportion to the flow. Settleable solids were determined hourly by Imhoff cones, using a two-hour settling period. Suspended solid determinations were made on four 6-hour composites by filtering known volumes through Gooch crucibles and weighing the solids retained after drying at 103°C. Other determinations were made on 24-hour samples. The temperatures of the sewage at the time of the tests averaged about 50°F.

Tables 1 and 2 show average results of suspended and settleable solids obtained over 12 and 24-hour periods. Table 3 gives more detailed results for the Hartford plant and shows daily variations over a week's period.

[1]Paper No. 65, Department of Sewage Disposal, New Jersey Agricultural Experiment Station.
[2]Dorr Sewage Research Fellow, N. J. Agricultural Experiment Station.

FEATURES OF INDIVIDUAL PLANTS

At Hartford the sewage is almost entirely domestic, from a separate system, and is about four hours old when it reaches the plant. The sewage passes through a bar screen having ¾ inch openings before it enters the tank through four submerged ports. The elevation of the bottom of the influent channel is slightly above that of the water level in the clarifier. The ports consist of 4" pipe extending down from the side of the influent channel to about two and one-half feet below the water surface. Elbows at the bottom cause the sewage to hit the wall before flowing across the tank.

The results show that the average 24-hour suspended solid removal was 55.8%, with a corresponding settleable solids removal of 93.3%, whereas the daytime removals were 61.3% and 94.0% respectively. Typical removals during the various parts of the day are given in table 4. This shows that the removals were highest during the period of high flow from 7 a. m. to 6 p. m. During the morning hours (from 1 to 6 a. m.) the effluent contained more suspended solids than the influent. This is due to the fact that the samples were composited without taking into consideration the detention period in the clarifier.

The pH values made on hourly samples showed that at about noon there was a sudden drop from 7.3 to about 5.8 each day. This was due to washings from three small local creameries.

The distribution of incoming sewage is not the best. The plant was designed for an aeration unit ahead of the clarifier and about one foot loss of head was allowed between bar screen and clarifier. This results in high velocity in the influent channel and consequently the ports do not pass an equal volume of sewage. The removals are good but would be better if the influent arrangement were improved.

TABLE 1

	Hartford, Wis.	Kiel, Wis.	Antigo Wis.	Ridgewood, N. J.	Sioux Falls, S. D.† (two)
Size of tank	30'x30'x5'2" s.w.d.*	20'x20'x6'8" s.w.d.*	35'x35'x6' s.w.d.*	46'x46'x6' s.w.d.*	70'x70'x10'3" s.w.d.* (one tank)
Capacity (gallons)	35,000	20,800	75,000	100,000	382,000
Average flow (g.p.d.)	212,700	115,300	605,000	665,300	1,570,000 (one tank)
Average detention period (hours)	3.95	4.31	2.97	3.60	5.73
Population (design)	5,500	2,000	10,000	20,000	53,000
Estimated present contributing population	2,750	1,040	5,600	8,500	28,000
Gallons per capita	77	111	108	78	56
Pounds dry solids per capita per year	62.5	44.9	49.9	32.9	38.8

*s.w.d. = side water depth.
†Sioux Falls plant designed to take care of city sewage from combined system and also packing house waste.

TABLE 2

12-HOUR COMPOSITES (7 A.M.—6 P.M.)

		Settleable Solids			Suspended Solids		
		cc. Per Liter		Per Cent.	Parts Per Million		Per Cent.
Plant	Date of Test	Inf.	Eff.	Removal	Inf.	Eff.	Removal
Hartford Wis.	Oct. 14-20, 1926	5.84	0.35	94.0	341	132	61.3
Kiel, Wis.	Sept. 9-16, 1926	2.69	0.11	95.8	191	91	52.3
Antigo, Wis.	Dec. 14-20, 1926	3.82	0.26	93.2	197	93	52.8
Ridgewood N. J.	July 4-6, 1927	6.94	0.03	99.7	212	45	77.8
Sioux Falls, S. Dak.	Sept. 1-2, 1927	7.26	0.11	98.5	362	75	78.2
	24-HOUR COMPOSITES						
Hartford Wis.	Oct. 14-20, 1926	4.24	0.28	93.3	267	119	55.8
Kiel, Wis.	Sept. 9-16, 1926	1.63	0.08	95.0	135	75	43.6
Antigo, Wis.	Dec. 14-20, 1926	2.47	0.15	94.0	152	84	44.7
Ridgewood N. J.	July 4, 1927	4.54	0.11	97.7	138	35	74.6
Sioux Falls, S. Dak.	Sept. 1, 1927	5.51	0.08	98.5	227	66	76.1

TABLE 3—HARTFORD, WIS., PLANT

12-HOUR COMPOSITES (7 A.M.—6 P.M.)

		Settleable Solids			Suspended Solids		
	Average Flow	cc. Per Liter		Per Cent.	Parts Per Million		Per Cent.
Date	g.p.m.	Inf.	Eff.	Removal	Inf.	Eff.	Removal
Oct. 14	199	4.78	0.28	94.1	321	102	68.2
Oct. 15	221	5.95	0.34	94.3	348	149	57.2
Oct. 16	216	5.12	0.31	93.9	312	117	62.5
Oct. 17	170	5.46	0.31	94.2	249	125	49.8
Oct. 18	228	8.13	0.45	94.5	538	162	69.9
Oct. 19	210	6.87	0.52	92.3	360	151	58.0
Oct. 20	199	4.57	0.27	94.1	248	119	52.0
Average	206	5.85	0.35	94.0	341	132	61.3
	24-HOUR COMPOSITES						
Oct. 14	143	3.61	0.25	93.0	240	94	60.8
Oct. 15	156	4.30	0.23	94.6	273	125	56.2
Oct. 16	153	3.69	0.26	93.0	234	106	54.7
Oct. 17	121	3.69	0.24	93.5	185	105	43.1
Oct. 18	155	5.92	0.40	93.2	420	159	62.1
Oct. 19	156	5.28	0.36	93.2	297	135	55.5
Oct. 20	150	3.18	0.21	93.3	196	103	47.4
Average	148	4.24	0.28	93.3	267	118	55.8

TABLE 4—HARTFORD WIS., PLANT

THURSDAY, OCT. 14, 1926

		Settleable Solids			Suspended Solids		
	Flow	cc. Per Liter		Per Cent.	Parts Per Million		Per Cent.
Time	g.p.m.	Inf.	Eff.	Removal	Inf.	Eff.	Removal
A.M. 1-6	78.2	0.41	0.17	58.5	55	68	—23.6*
A.M. 7-12	189	5.21	0.25	95.2	272	87	68.0
P.M. 1-6	175	4.30	0.31	92.8	374	118	68.4
P.M. 7-12	128	2.28	0.16	93.0	122	88	28.7
Weighted average	143	3.61	0.25	93.0	240	94	60.8

*Note—Samples composited disregarding detention period, hence, the effluent from 1—6 A.M. contained more solids than the influent.

The presence of creamery waste also tends toward lower removals.

The Kiel plant was similar in design to that at Hartford. Here, the sewage was fresh, entirely domestic from a separate system. The amount of infiltration, however, was excessive. In times of heavy rain the detention period was as low as twenty minutes. At the time of the test there was considerable rain so that the flow was above normal and the removals low. The influent channel was similar to that at Hartford, but there was no disturbing action, as the incoming sewage had a relatively low velocity and distributed fairly evenly through the four ports.

At Antigo, the sewage passes through a bar screen and a grit chamber before entering the clarifier. An adjustable weir gives good distribution of the incoming sewage. At the time that the test was made, 19,000 pounds of whey from a local cheese factory was coming into the plant. Since August, 1927, the whey has been taken out so that at present only the wash water is coming in. This whey caused the entire sewage flow to become acid and prevented efficient settling. It will be noted that the settleable solids removals are high while the removal of suspended solids is comparatively low. This is because most of the whey was in a semi-colloidal state and would not settle readily. This material behaved like ordinary creamery wastes in that it would flocculate and settle on standing for about 24 hours when a high acidity developed.

At Ridgewood, the sewage is fresh, strictly domestic and from a separate system. It passes through a bar screen and a Dorrco fine screen before entering the clarifier. The influent channel and weir are submerged. The distribution appeared to be very good.

As the results show, the removals of suspended and settleable solids at this plant are very high despite the low solid content of the influent and the fact that a fine screen precedes the settling tank.

The Sioux Falls plant has two clarifiers which receive the city sewage from a combined system and also the waste water from a local packing house. At the time that the test was made, one clarifier was being used as only the city sewage was coming in. This sewage passes through a bar screen and a grit chamber before entering the clarifier through six submerged ports. Each opening can be regulated by sluice gates. The results show that the removals were very good.

In all these tanks the effluent goes out over a weir extending across the entire tank. A baffle prevents grease or other floating material from going out with the settled sewage. The incoming sewage is baffled to prevent short circuiting.

TABLE 5—BIOCHEMICAL OXYGEN DEMANDS, TWO DAYS AT 20 DEGREES C.

24-HOUR COMPOSITES.

	Influent	Effluent	Per Cent. Reduction
Hartford	219	155	29.2
Kiel	92	80	13.0
Antigo	158	136	13.9
Ridgewood	129	83	35.7
Sioux Falls	81	65	19.8

TABLE 6—HARTFORD PLANT. B.O.D., TWO DAYS AT 20 DEGREES C.

24-HOUR COMPOSITES

	Influent	Effluent	Per Cent. Reduction
Oct. 14	231	109	52.8
Oct. 15	217	177	18.4
Oct. 16	159	122	23.3
Oct. 17	234	144	38.5
Oct. 18	282	218	22.7
Oct. 19	222	167	20.3
Oct. 20	187	151	19.2
Average	219	155	29.2

SCUM

Except for oil, grease and other non-settleable solid matter, no scum (i. e., gas lifted sludge) has been observed by the writer in any of the tanks. This greasy film usually accumulates in one corner and as a rule does not cover an area more than about 25 square feet. Large amounts of oil, presumably garage wastes, are continually coming into the Kiel, Ridgewood and Sioux Falls plants. This oil is skimmed off periodically.

Except at Hartford and Kiel, there is some sedimentation in the inlet channels due to the low velocities, as the plants are far below capacity at present.

SLUDGE PUMPING

The settled sludge is pumped daily at all plants by means of 4 inch diaphragm pumps of the pressure type operating at about 25 to 40 gallons per minute. The time of pumping and density of the sludge vary at each plant.

At Hartford and Kiel, the pumping time is 15 to 20 minutes daily, the sludge having an initial solid content of about 7.5 to 8%. At Antigo, sludge is pumped for an hour with the solid content from 12% at the beginning of pumping to 1% at the end. The pump at Ridgewood is operated three times daily, twenty minutes each time, giving a sludge averaging about 3% solids.

A continuous pumping test run at Sioux Falls produced a sludge containing an average of well over 5% solids, with pump delivering about 10 g. p. m. The maximum solid content was 31.9%.

At smaller plants such as Ridgewood the practice is to pump sludge until the solid content drops to about 1%. This is done because the amount of sludge handled at a small plant each day is not large. Although the solid content could be increased by keeping it in the clarifier for a longer time, such a procedure would be undesirable, as the sludge would then become more acid and would be more difficult to digest. In larger installations, however, such as at Sioux Falls, continuous pumping at low stroke is entirely feasible, with the production of a thick fresh sludge.

REMOVAL OF SOLIDS

In general, the tables show that the removal of *settleable* solids was uniformly high at all the plants, while the suspended solids removals varied considerably. The Ridgewood and Sioux Falls clarifiers gave best results, while those at Antigo and Kiel were lowest. These differences are due primarily to the varying character of the sewage, the presence of trade wastes and other local factors.

At Antigo, the acid cheese waste undoubtedly lowered the suspended solid removals; while at Hartford, the disturbing action of the incoming sewage affected the results. The Ridgewood removals are remarkably high in view of the fact that the sewage

was comparatively weak and that the settling tank was preceded by a fine screen.

For each plant, as a rule, the stronger the sewage the higher were the removals. This is shown very well in the Hartford results for suspended solids.

Comparisons of flow show that the Sioux Falls per capita flow was lowest, although it was from a combined systems. These flows were measured during a dry period. The flows at Ridgewood and Hartford are about the same, while those at Antigo and Kiel are considerably higher. This was due to large amounts of infiltration at the latter two places. At Kiel especially, the flow was excessive in times of rain.

The suspended solids in the raw sewage also showed considerable variation, Hartford sewage having the greatest per capita content, 62.5 pounds per capita per year or 77.7 grams per capita per day. At the other plants these figures were much lower. Estimating the screen removal at about 15% for Ridgewood, the raw sewage has a dry solid content of 38.5 pounds per capita per year. The average for the five plants, then, would be 46.9 pounds per capita per year or 57.5 grams per capital per day.

B. O. D.

Biochemical oxygen demand figures given in table 5 show that there was a reduction through the clarifiers at all the plants. These reductions follow somewhat the suspended solids removals in all cases except at Sioux Falls, where the reduction was lowest, although the solids removals were highest; but table 6 shows that at Hartford there was no general relation between solids removal and B. O. D. reduction.

These determinations were made using tap water for dilution. The dilution used in all cases was 1 part sewage to 50 parts of aerated water. The incubation period was two days.

SUMMARY AND CONCLUSIONS

Removal tests were made at five sedimentation tanks of the same type.

These tests showed that the removal of settleable solids as determined by Imhoff cones were uniformly high while suspended solid removals varied considerably.

The latter results are not comparable for the different plants because of local factors, presence of trade wastes and differences in character of the sewage.

At Ridgewood and Sioux Falls very good results were obtained, the 24-hour removal of suspended solids being 74.6% and 76.1% respectively.

At Hartford, although the results were good, the removals were lowered, due to agitation by the incoming sewage.

Results at Antigo and Kiel were lowest. At the former plant the presence of cheese factory waste making the entire sewage flow acid, lowered the removal of suspended solids considerably. At Kiel the removals were low principally because of the weak sewage coming into this plant.

The average flow for the five plants tested was 86 gallons per capita, and the suspended solid content of the raw sewage, 46.9 per capita per year or 57.5 grams per capita per day.

Biochemical oxygen demand determinations showed that although there was a reduction through all the clarifiers tested, the decrease did not follow the suspended solids removals in all cases.

Acknowledgement. The writer is indebted to the designing engineers of the various plants, the Dorr Company, the city officials and plant operators, for their valuable assistance and criticisms in the preparation of this work, which was carried out in connection with the Sewage Research Fellowship at Rutgers University under the direction of Dr. W. Rudolfs.

Mechanical Aerator for Activated Sludge, at Princeton, Ill.*

Description of plant and result of first year's operation. Comparison of results with those by air diffusion method.

By F. C. Roe†

Princeton is the county seat of Bureau county, in the north central part of the State. It is a farming community of about 5,000 population and there are no industries or special features affecting the quality of the sewage. Ground water infiltration increases the average flow from 300 g. p. m. to about 500 g.p.m. beginning approximately 12 hours after a rainfall of ½ inch per hour or greater, and lasting at least 48 hours after the storm has ceased.

The city had been served for twenty-six years by a septic tank and contact filter bed. The plant was not cared for, was greatly overloaded and had become obsolete. The total septic tank capacity of 6400 cu. ft. was designed to give a retention period of three hours to the sewage, but recent observations showed about twenty minutes retention. The filter bed had an area of 1,920 sq. ft. or .044 acre and was expected to operate at a rate of two million gallons per acre per day. This bed had become clogged in recent years, since the rate of filtration would have had to be over 11 million gallons per acre per day, in order to operate. As a result, the effluent from the septic tank ran over the side walls of the bed and eventually into the creek. Due to the conditions mentioned, the creek into which the effluent discharged became badly polluted and damage suits totalling $20,000 were brought against the city by riparian owners downstream. Action was withheld pending construction by the city of an adequate treatment plant.

Accordingly a report and design were presented in order early in 1927 at which time the city attempted to organize a sanitary district to finance the project. The proposed sanitary district was voted down, but a $50,000 city bond issue to finance the project was passed later. Bids were opened in July and the contract awarded to The Priester Construction Company of Davenport, Iowa. Con-

*From a paper presented before the Illinois Society of Engineers, Jan. 24, 1928.

†Of Shields, Jordan and Roe, Engineers, Chicago.

struction began late in August and has been carried on without cessation to date.

The plant is designed to care for ½ m. g. d. and consists of a grit and coarse screen chamber; a preliminary settling tank with one hour detention period; five aerating units using Simplex mechanical aerators, with an 8-hour detention period during the sixteen hours of maximum flow; a final settling tank having a detention period of two hours; and a pump house.

All tanks are uncovered and are of reinforced concrete construction treated with two coats of a bituminous waterproofing. The pump house is of brick construction and contains two double-acting plunger pumps for pumping sludge, a wash-water pump, a sludge division box, and electrical control equipment. The old septic tank was converted into a separate sludge digestion tank and the old filter bed into a sludge drying bed.

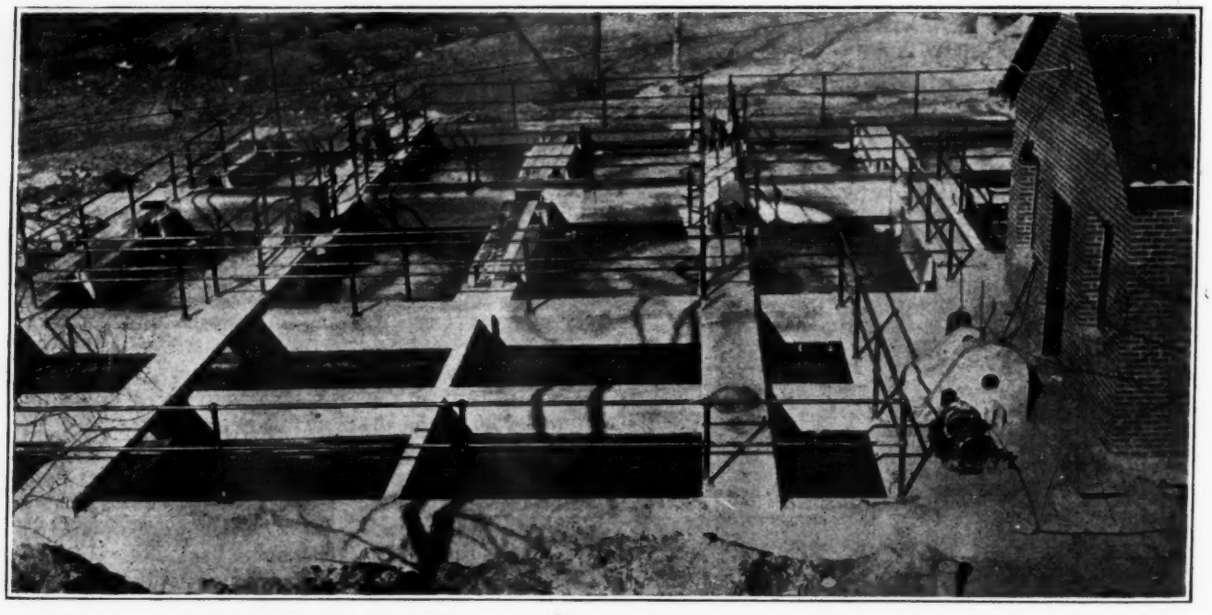
Sludge is to be collected in the flat-bottomed preliminary tank by means of two flights of Link-Belt sludge collectors and pumped from the hoppers directly to the sludge digestion tank. The settled activated sludge in the final tank is likewise to be collected by two flights of Link-Belt sludge collectors and will be pumped from the hoppers to the division box in the pump house. A portion of the sludge will be separated here to flow by gravity to the first aeration unit. The remainder will flow to the digestion tank where it will mix with the fresher solids from the preliminary settling tank. The percentage of sludge to be returned to the influent will be regulated by a movable partition on the face of a weir in the aforementioned sludge division box.

A feature of the plant is flexibility of operation. Either preliminary or final settling tanks may be by-passed in case of a breakdown, and the first or last aerating tanks used for settling purposes, since there is a suction pipe connected to the pumps from the bottom of each tank. Also any of the aerating tanks may be cut out. A temporary overflow weir is provided to care for the excess ground water infiltration following a storm. The city expects to reconstruct and add to its storm sewer system which will relieve the territory now causing excessive infiltration.

As there is little general knowledge in this country of the use of Simplex mechanical aerators in the activated sludge process of sewer treatment, it will not be foreign to the subject if something of the history and operation of this method of surface aeration is given.

The Simplex aerator was invented in 1919 by Joshua Bolton, manager of the sewage treatment works at Bury, England, and was installed in that city under the supervision of the Ames-Crosta Engineering Company of Nottingham, England which patented the process. The plant at Bury has been increased until it now contains 117 units. Other plants have been built at Bolton, Macclesfield, Birmingham, Manchester, Epsom, Huddersfield and many other places in England and Scotland. Most of these have developed from experimental plants into service units and range in size from 1/10 to 2½ m. g. d.

The first installation in the United States was an experimental unit at the Desplaines river sewage treatment works of the Sanitary District of Chicago. Experimental data were gathered there over a period of 18 months, beginning in September 1923, and showed good results. Other experiments were carried on in 1924 at Argo, Ill., Decatur, Ill., and Houston, Texas, on trade wastes. Permanent treatment works were constructed in 1925 at Colorado, Texas, and Glen Lake, Minn.; in 1926 at Rochester, West Concord, and Buhl, Minn.; Garden Villas, Texas, and Los Gatos, Calif.; in 1927 at Norwood, North St. Paul and White Bear Lake, Minn., Dunsmuir, Calif., and Princeton. All of these installations were made by the Simplex Ejector Company, which has sole rights on the apparatus in the United States, and are the manufacturers.



SIDE VIEW OF PRINCETON AERATORS—SETTLING TANK IN FOREGROUND—PUMP HOUSE AT RIGHT
Four aerator motors seen in center and rear of picture, with aerator under each

The Simplex system produces an activated sludge by bringing the sewage in contact with the air at the surface instead of bringing air in contact with the sewage below the surface, as in the case of the more widely known air diffusion process.

A circulatory course is obtained the purpose of which is to accomplish what spiral flow does in some air-diffusion installations. A flocculent sludge is developed after an aeration period of from four to ten hours, depending upon the strength of the sewage. Earlier installations were driven by a line shaft with a motor at some protected central point which enabled one motor to drive five or six units. Recent installations, such as at Princeton, have an individual motor and drive for each unit, which increases the flexibility of the plant as a whole.

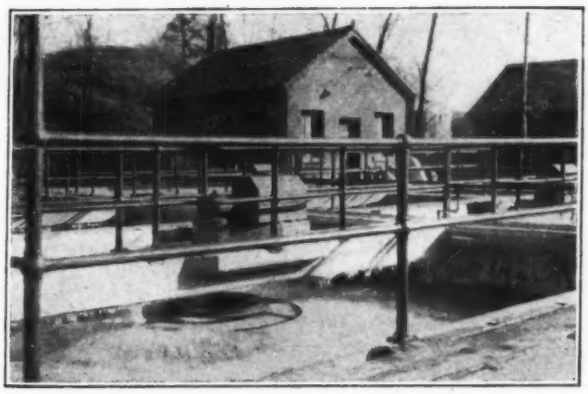
The results in England on sewage which is relatively stronger than American sanitary sewage show a reduction in suspended solids that compares favorably with the results obtained by the diffusion method. Similar results have been obtained in the United States; for instance, at Houston, Texas, where a direct comparison was made, the 5-day b. o. d. on sewage aerated for six hours showed a reduction of from 1,590 to 216 p. p. m., or 86% for the Simplex aerator, and from 1,675 to 397 p. p. m. or 78.5% for the diffused air process. When aerated for eight hours, the reduction was from 1,075 to 136 p. p. m., or 87.4% for the Simplex aerator, and from 1,676 to 86 p. p. m., or 95% for the diffused air process.

The cost of installation in England has been about $65,000 per million galls. per day for both the Simplex and the air duffusion methods, but the power required per million gallons is about 15 h. p. for the Simplex as compared to 25 h. p. for air diffusion. The initial cost in America ranges from $60,000 to $100,000 per m. g. d. and is somewhat less than the cost for the air diffusion process, which ranges from $80,000 to $120,000 per m. g. d. Power required is higher in the United States because longer periods of aeration are given, a minimum figure being about 20 h. p. per million gallons for Simplex aeration and from 24 to 50 h. p. for million gallons for air diffusion.

Judging from the above information it seemed safe to assume that an activated sludge plant of the Simplex type was not only practical but economical for either large or small installations and could be used with success at Princeton. An Imhoff tank sprinkling filter plant would have cost upwards of $80,000, while the cost of the activated sludge plant installed was about $51,000. The interest of some $4.00 per day on this apparent saving of $30,000 will more than balance the power costs, assuming a price of 3c. per k.w. hour. Princeton owns its own power plant and although the writer had no definite data available on the local production cost of power, it is probably less than the 3c. per k.w. hour assumed.

The city has constructed a seven-room house on the premises and a local man has been engaged as operator. There is no chemical laboratory in connection with the plant, but sufficient apparatus will be provided and tabulated results kept from the beginning of operation.

The above paper was ready on January 4. Operation of the plant started on January 20 and has been continued without interruption since then. Mr. Roe informs us that flow of sewage has increased, due to excessive infiltration, and the load, which is normally 600,000 gallons per day, has been as high as 1,000,000 gallons per day. This excess will be remedied by repairs to the sewerage system, closing all gutter and storm drain inlets if any are discovered, and sealing manhole covers. A comprehensive survey of the sewerage system is being carried on to correct the trouble and storm sewers are to be constructed.



PRINCETON AERATOR IN OPERATION

The aerator has been overloaded due to the excessive flow and requires slightly more than 2 h. p. during the 600,000 gallons per day average peak load flow, or 11 h. p. for the five aerators. This would be about 18.3 h. p. required per million gallons. However, the horse power requirement does not increase in a straight line as the flow increases or decreases, but 20 h. p. per million gallons is a fair limit of power requirement.

Activated sludge began to build up steadily as soon as the plant started and has increased steadily until the quantity is now about 18% of the flow. All of the activated sludge is being returned at present, but the excess will be diverted to the digestion tank as soon as result determine that there is an excess. The apparent long time required to develop an activated sludge is due to the efficient settling of heavier solids in the preliminary settling tank, thereby reducing the quantity of solids delivered to the aeration units.

There has been no trouble with ice, although several periods of zero weather have existed.

There are no odors except from the sludge digestion tank, and this is covered with a brick building, thereby decreasing any objectionable conditions in the vicinity of the plant.

The only regular daily test that has been run to date is the methyline blue stability test. With one exception the samples have stood up for twenty days or more. The exception stood up for six days and was taken on a day when the flow increased suddenly, bringing with it a mass of black septic sludge which had probably accumulated at some point in the system due to a stoppage. Tests are being run at present by the Illinois State Board of Health engineers on dissolved oxygen, biochemical oxygen demand, total solids and stability.

The last test on a 24-hour composite sample of

the effluent showed a biochemical ogygen demand of 12.25 p. p. m.

The Simplex Ejector & Aerator Corporation has had a representative watching operations since the plant started.

Planning Development of Water Distribution System*

How Kenosha, Wis., based its plans for extension of distribution system upon survey of present weak points and future requirements.

By P. J. Hurtgen†

The city of Kenosha, Wis., passed a zoning ordinance in 1924, and has since carried out all of the development plans based on the plans outlined in this ordinance. In this connection it seemed advisable to have a survey made of our water-works distribution system in order to determine the adequacy of our present system and our requirements twenty-five years hence. The Pitometer Company made a survey of the system to determine whether or not water was being wasted through leaky mains and services from which the city procured no revenue.

About a year ago the water department had a complete survey made of the entire distribution system in order to determine whether or not the plan of construction that was being followed, with special reference to the capacity of the water mains, was an adequate and economical plan. Based on this survey, plans were recommended for a construction program for the next twenty-five years.

The study made by that company's engineers was a comprehensive one and may be outlined under the following items:

1. A study of the probable increase in population during the next twenty-five years, both in the city as a whole and in various sections. Studies of the probable location and growth of industrial districts.
2. A study of the present water consumption and fire protection requirements in various sections of the city and a determination of the probable water consumption and fire protection requirements twenty-five years hence.
3. Investigations to determine the loss of head and coefficients of friction in trunk mains. Investigations of such points in the distribution system where present facilities appeared to be inadequate, to determine if replacements, extensions or cleaning of the mains are necessary.
4. Design and general details for reinforcing mains necessary to meet present needs and future requirements.
5. General plans and recommendations for an economical program of construction.

Population Increase.—Based on the past growth of the city covering a period of years, a population chart was prepared and the population curve covering that period was projected to cover the period twenty-five years hence. By using the school census, voting statistics, meter records and a study of the zoning ordinances, an independent determination was made of the present and probable future populations of each of the twelve wards separately. The estimated population of the city taken by wards differed by only 1,000 from the figure shown by the population curve for the entire city. The rate of growth in population of each ward was based on the school census. A study was made of each ward separately to determine the type of development permitted under the zone ordinance, giving consideration to residential, industrial and mercantile development and areas in which apartment houses might be located. Consideration was also given to areas set aside for park purposes.

Water Requirements.—Based on a chart showing the yearly pumpage from 1896 to the present time, the Pitometer Company made a new chart showing the average daily pumpage for that period, together with their predictions for future consumption.

Pitometers were placed on each of two 24-inch mains which bring the water to the city to measure the total consumption for 24 hours, the night rate and the maximum for one hour. The industrial consumption, based on meter readings, was then deducted from the total to determine the domestic consumption and water used from fire hydrants. Based on the population at this time, the total consumption was 107 gallons per capita per day, and the domestic consumption 56 gallons per capita per day. From the pumpage records and meter readings for the entire year 1926, the total consumption per capita was 104 and the domestic consumption 62 gallons.

The industrial and domestic use were plotted separately and the two combined to arrive at the total consumption. In order to determine the increase in industrial use, the total consumption was plotted for nine of the largest plants, covering water consumption for six years, which was used as a guide for determining the industrial consumption. To this was added an amount estimated to take care of new industries.

The domestic consumption was arrived at by multiplying the estimated population in 1951 by 60, which figure was taken as the domestic per capita consumption per day. The result of this computation gave a total water consumption in 1951 of 103 gallons per capita.

In addition to these studies, and as a basis of comparison, studies were made of each ward separately, to determine its present consumption. The following excerpts taken from the report of the engineers will give a clearer idea of the method used in calculating the consumption for each district:

Wards 3 and 4

This section includes the business districts, several large factories, and one of the best residential districts. At the

*From paper before the Wisconsin Section of the Am. Water Works Association.

†Commission of Public Works, Kenosha, Wis.

time of measurement, the industrial consumption was 441,000 gallons per day. By using the past growth of the Simmons Company as a guide we have estimated the increase in industrial consumption as 40 per cent for the twenty-five-year period.

140 per cent of 441,000	628,000	g.p.d. Industrial
1951 estimated population is 17,000 17,000 X 60	1,020,000	g.p.d. Domestic
	1,648,000	g.p.d. Average daily consumption in 1951
Add 50 per cent for summer rate	824,000	
	2,472,000	
Add 50 per cent for maximum hour	1,236,000	
	3,708,000	g.p.d. Maximum consumption in 1951

The estimate of total consumption for 1951, taking each ward separately, was 25,457,000, as compared with 24,975,000 gallons as shown on the projected chart considering the city as a whole.

Determination of Loss of Head and Weak Points.—A study was made of the distribution system to determine the amount of frictional resistance in the present supply mains. The main trunk lines were used for this test, and simultaneous reading taken at each end of a section of main, averaged over a considerable period of time. While the gauges were in operation, all side feeds were valved off, and a pitometer was used on the main to measure the flow. These tests were made on stretches of pipe that served only small consumers in order to eliminate as much as possible losses from domestic consumption. The result of these tests showed that the water mains were not corroded to any appreciable extent. The coefficient on the pipe ranged from 99 to 135, while the coefficient for a new pipe and pipe in use only a few years usually averages from 100 to 130.

The weak points in the distribution system were investigated by taking pressures by test gauges fitted into a hydrant cap and attached to the hydrants, recording these pressures and noting low pressure areas on the map. Then the flow in the trunk mains was gauged for 24 hours to determine the velocity of flow in feet per second. These tests were made with all valves open in order to get the flow under normal conditions.

These tests showed that the north 24-inch feed main carried about 50 per cent more water than the south 24-inch feed main, notwithstanding the fact that the largest consumption lay south of the plant; also that the flow on a certain street in a 6-inch main was toward the pumping station instead of the opposite direction, due to the fact that a number of large meters on this line were supplying water to one of the largest factories.

Design of Distribution System.—From these surveys the weak points in the distribution system were disclosed and data procured for the consideration, design and location of reinforcing mains to meet these requirements.

The first consideration was given to the two 24-inch mains leading from the pumping station. During the year 1926 the maximum pumpage for one hour reached the rate of nearly 16,000,000 gallons per day. The Fire Underwriters require that provision be made for two fires, one in the high value section requiring 5500 gallons per minute, and another in an outlying section requiring 1500 to 2500 gallons per minute. Seventy-five hundred per minute or 10,800,000 gallons per day, therefore, were considered adequate for fire purposes. This amount added to the 16,000,000 amounted to 26,800,000 gallons per day or a velocity of 6.6 feet per second for these two mains. This was considered high, but because of the fact that the mains were short in length and high in coefficient this was considered satisfactory for the present.

As stated before, the estimated rate of consumption for 1951 was about 25,000,000 gallons per day. Adding to this the fire requirements of 10,800,000 gallons, the maximum demand for that year was found to be 35,800,000 gallons per day. This would give a velocity of 8.8 feet per second in the two 24-inch mains, which would mean a loss in the head of about 16 pounds. While the velocity is close to the limit of the capacity of the mains, the short distance to the heart of the business district makes the velocity allowable. The capacity of these 24-inch mains was therefore considered ample for the next 25 years.

Separate calculations were made for the requirements for each district, usually composed of two wards, and additional mains were recommended of such sizes, consistent with proper velocities, as would supply the district under consideration.

In addition to the report submitted in connection with this survey, the Pitometer Company submitted maps on which were shown the sizes of mains recommended for the entire city and the territory contiguous to the city for 25 years hence. A construction program in five-year cycles to be followed in the order of their importance was also outlined in the report.

Mr. Hurtgen expressed confidence that the result of the study will save the department many times the cost of the survey, by giving it a definite plan to follow for future extensions to the distribution system.

Approval of Sewage Plans in New York

The Public Health, County, Town and Village laws of New York State relating to the approval of plans for sewerage and sewage and waste disposal have just been amended by the Legislature. These amendments (effective March 19, 1928) provide for re-transferring the authority for passing upon such plans from the State Engineer to the State Department of Health, which authority was transferred to the State Engineer in 1921.

These laws as amended now require the submission to, and approval by, the State Department of plans for sewerage and sewage and waste disposal and of modifications and extensions thereof, for municipalities, institutions and private buildings and industrial establishments. The Public Health Law also requires the securing from the State Commissioner of Health of permits for the discharge of sewage, sewage effluents and industrial wastes into the waters of the state, as has been the case since the enactment of the so-called Anti-Pollution Law in 1903.

Grade Crossing Elimination in Westchester Co.

In planning 140 miles of new routes, nearly two hundred highway crossing separations are provided for, thirty-two of which have been constructed and funds are available for six others

By L. G. Holleran*

Westchester County is what may be called the front door yard or vestibule of the city of New York and a large proportion of the traffic from the city to the north and east passes up through the county on two principal highways; the Boston Post Road on the east side parallel to Long Island Sound, which carries the most intensive day and night traffic of any road out of the city; and the Albany Post Road parallel to the Hudson river on the west side.

Each of these is an ancient highway which passes through the business center of every city and town which it traverses. The result is that the through traffic super-imposed on the local business traffic has brought about intolerable conditions on these through roads. The traffic on other main highways throughout the county has also increased beyond their capacity.

In 1922 prominent business men and county officials realized that something radical must be done in order to provide recreational facilities and remedy the traffic situation before the development of the county was seriously retarded. The result was the passage of an Act by the New York State Legislature empowering the Westchester County Board of Supervisors to appoint commissioners to constitute a Westchester County Park Commission.

As a result of its studies, begun in 1922, the commission came to the conclusion that the solution of the traffic problem lay in the construction of additional traffic routes up through the county parallel to the Albany Post Road and Boston Post Road, but away from the business sections of the municipalities through which they were to run. Also the construction of additional cross county routes.

As studies for the particular routes and parks were completed, funds were made available by the Board of Supervisors, the necessary lands were purchased and construction work started on some of the routes. The total amount appropriated to date is about $46,800.000, of which about $30,700,000 was for land and about $16,100,000 for construction.

In planning the 140 miles of new routes shown on the map Figure 1, the grades at all principal highway intersections have been separated; curves super-elevated; the radii of curves kept to a minimum of 700 feet, and a modern lighting system installed.

The advent of 23,000,000 automobiles on our highways with the resulting traffic congestion has brought about a demand for the separation of grades at the principal highway intersections near centers of population. These separations are considered necessary in order to increase the capacity of the highways, promote safety and reduce the monetary losses due to the stoppage of motor vehicles at such intersections.

Attempts to evaluate the losses due to delays at grade crossings have been made. In a paper entitled "Grade Crossings: The Money Value of a Car-Minute," Fred Lavis, consulting engineer for the New Jersey State Highway Commission, concluded that the average cost of a passenger car minute is 1.0 cent, for smaller commercial vehicles 2.2 cents, and for trucks 2.3 cents. Others have estimated as high as 3 cents per car-minute for passenger cars and 5 cents for trucks.

With these car-minute costs as a basis and considering the number of vehicles delayed at grade crossings every day, it can readily be seen that the annual losses due to such delays must be enormous. It has been estimated that the cost of vehicular congestion on Manhattan Island alone totals $500,000 per day and in the entire New York region amounts to as much as $1,000,000 per day. The losses in the regions of other centers of population are no doubt in proportion.

The question arises as to how much the authorities are justified in spending to minimize such losses by the elimination of highway grade crossings.

The State of New Jersey is constructing a new through traffic highway from the westerly end of the Holland tunnel to a point near Elizabeth, New Jersey, a distance of about 13 miles, at a cost of over $30,000,000, which is designed to carry 20,000,000 vehicles per annum. Mr. Lavis in the above mentioned paper has calculated that the State would be justified in spending $6,600,000 to eliminate one crossing, $7,200,000 to eliminate three crossings, and $8,000,000 to eliminate five crossings.

By means of a traffic census, observations of average delay or reduction in capacity of any particular highway, together with the car-minute costs given above, an approximate estimate of the amount which it would be justifiable to expend in the elimination of any highway grade crossing can be arrived at.

The ideal arrangement at a highway grade crossing elimination provides access roads at all four corners, as indicated in Figure 2. In built-up sections, however, such an arrangement is often impracticable, except at prohibitive expense, due to the location of costly buildings or other structures, or topo-

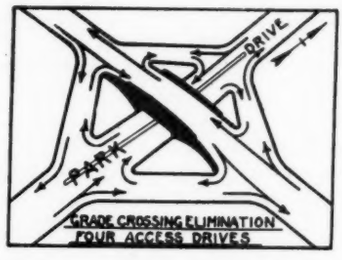


FIG. 2.—IDEAL ARRANGEMENT FOR ACCESS BETWEEN ROADWAYS AT GRADE CROSSING SEPARATION

* Member, American Society of Civil Engineers; Deputy Chief Engineer, Westchester County Park Commission.

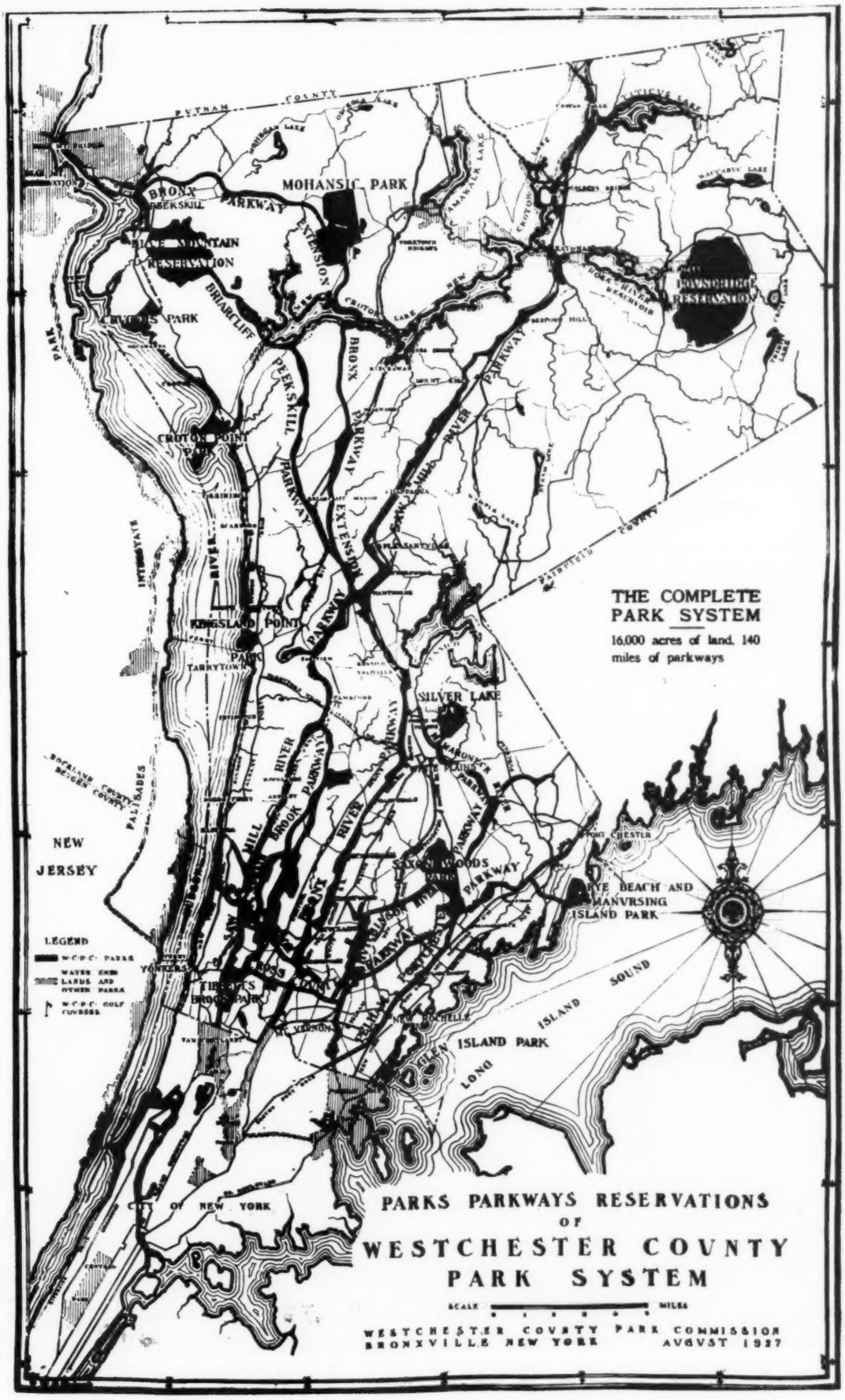


FIG. 1—SHOWING 140 MILES OF NEW PARKWAYS PLANNED FOR THE COUNTY

graphical features in one or more of the corners. We have constructed a number of eliminations with two access roads. In a few cases only one access has been built. This form is undesirable and should be avoided if possible.

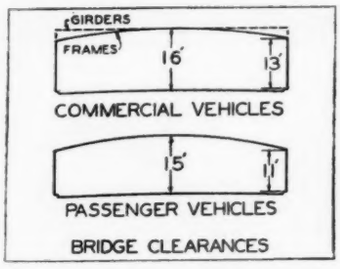


FIG. 3—BRIDGE CLEARANCES, WESTCHESTER CO. PARK SYSTEM

Figure 3 shows the clearances we are providing for our grade separations. Most of the principal highways in the lower part of the county are planned for an eventual width of 60 feet of pavement and bridges over the driveways are built accordingly. The minimum clearance at the curb is 11 feet and at the center of the arch 15 feet.

To date the commission and its predecessor, the Bronx Parkway Commission, have constructed thirty-two highway crossing separations. Funds are available for six other separations, and the completion of the parkways which have already been approved will require more than one hundred additional. In view of their location in the midst of naturalistically landscaped parkways, especial care is necessary in the design of these grade crossing elimination structures.

It is expected that a speed of 40 miles per hour will be allowed on the new parkway drives.

In response to public demand, the commission has employed architects on all its bridges and highway grade crossing elimination structures. The architects are furnished with limiting dimensions and with that as a basis they furnish the Commission with sketches showing their ideas of architectural treatment. These sketches are examined as to economy and appearance. If unsatisfactory, other architectural sketches are furnished until a satisfactory design is found.

It is often a difficult problem to adapt structural forms to satisfactory architectural requirements, but

FIG. 4—GRADE CROSSING ELIMINATION ON BRONX RIVER PARKWAY

if there is a genuine desire to do so the requirements of the engineer and architect can be reconciled without sacrificing the essentials of either.

Examples of collaboration between the engineer and architect are shown in the various bridges and grade crossing elimination structures used to illustrate this article. Figure 4 shows a stone faced reinforced concrete highway grade crossing elimination structure.

Examples of reinforced concrete construction which attain satisfactory architectural requirements are shown in Figures 5 and 6 respectively. Figure 7 shows a form of steel construction which was developed to take the place of the steel plate girder design originally proposed. In view of the very appreciable cost of these structures, economy of design is essential.

In a number of the simpler cases where the intersecting highways were carried over the parkway drive, the structures alone, including stone facing but exclusive of the excavation above the grade of the parkway drive and exclusive of paving, cost only $50,000 to $55,000. In other cases where the parkway drives were carried over the intersecting streets and large quantities of fill were needed in the approaches, the separations, including approach fill but exclusive of paving, have cost up to $100,000 and in a few cases as much as $150,000.

The structures shown indicate what can be done in the way of design by whole-hearted cooperation between the engineer and architect. It has been evident to the writer for some time past that unless

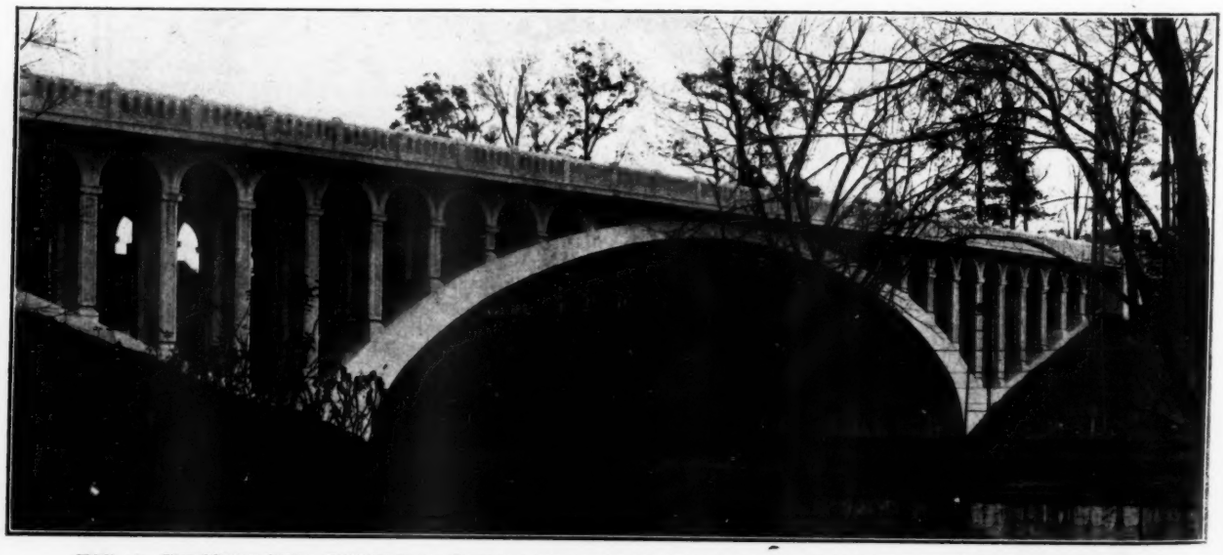


FIG. 6—REINFORCED CONCRETE BIDGE ON BRONX RIVER PARKWAY AT WOOLAND PLACE, WHITE PLAINS

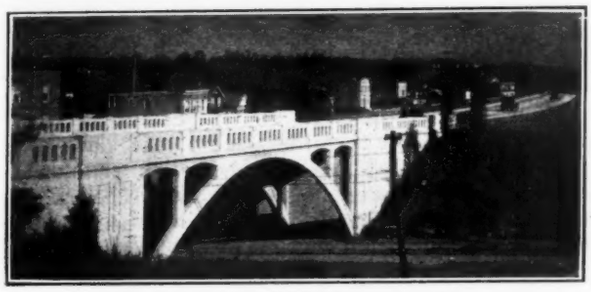


FIG. 5—REINFORCED CONCRETE GRADE CROSSING ELIMINATION STRUCTURE, LAKEWOOD AVE., YONKERS

the engineer voluntarily collaborates with the architects in the design of his structures the time is not far distant when he will find himself in a subordinate capacity making the structural designs as an employee of the architect.

It is not sufficient, as many engineers seem to think, to turn over a completed structural design to an architect to "doll up." The lines and mass of the structure are of much more importance than the ornamentation. The architect ought to be in on the design from the outset.

It has been the experience of the commission that architecturally attractive bridges which harmonize with their surroundings can be constructed at little or no increase in cost over the usual hap-hazard designs prepared wholly by the engineer.

The tendency of the present time in bridge design, as the writer sees it, is toward the sort of cooperation between engineer and architect which has made possible the bridges constructed by the Bronx Parkway commission and Westchester County Park Commission.

Another article describing the designing of the county bridges, by Arthur G. Hayden, will appear in the June issue.

Water Consumption in New Bedford

Of the total of 19,100 water services in use in New Bedford, Mass., at the end of the year 1927, 18,063 were metered, or 94½%, according to the annual report of S. H. Taylor, superintendent of water works of that city. The average consumption for the year was 67.3 gallons per capita, which was 2 gallons more than in 1925 and 1926, but less than for any year prior to that time.

Of this total consumption of 67.3 gallons, only 7.09 gallons was unaccounted for. By meter measurement (without allowing for under-registration of meters), 28.6 gallons per capita was used for manufacturing purposes, and 30.8 gallons for all other metered uses. This leaves 7.9 gallons to cover leaks, flushing, fires, under-registration of meters, and all other unaccounted for uses.

This is equivalent to 42.5% for manufacturing uses, 45.8% for all other metered uses, and 11.7% for leaks and all other unaccounted for water.

Mr. Taylor assumes that 3% is a fair allowance for under-registration, which would leave 8.7% for leaks, flushing, fires, and unaccounted for, which is very low as compared with many other cities.

Maintenance of Secondary Type Roads*

Methods employed in maintaining nineteen thousand miles of roads in Minnesota, of which fourteen thousand are gravel. Team and truck patrol. Surface and subgrade treatment

By W. F. Rosenwald

Maintenance of highways is complicated by the ever increasing volume and weight of traffic and insistence of users of the highways on greater comfort and better service. The maintenance of any given road is therefore an ever changing problem, requiring new methods and new operations. This is most evident on the secondary or cheaper type of roads, the capacity of most of which is being taxed to its limit at all times, which necessitate working out some relief which will serve until a higher type of road can be constructed. The increasing demands of traffic can be met either by gradual betterment as the traffic increases, or abruptly by reconstruction when the road will no longer carry the traffic.

The maintenance problem in Minnesota involves the upkeep of 7,000 miles of state maintained roads, of which 5,500 miles are gravel surface; and of 12,000 miles which are county maintained with state aid, of which 9,000 miles are gravel surface. A large number of traffic counts on the state maintained system have been taken systematically during the past seven years, and these indicate the average rate of increase in volume of traffic is somewhere between 20 and 25 per cent per year. On the state maintained system the average daily traffic now is 940 vehicles per day, ranging from 144 as a minimum

* Abstract of paper presented at the recent Road School at Purdue University.

† Maintenance Engineer, Minnesota Department of Highways.

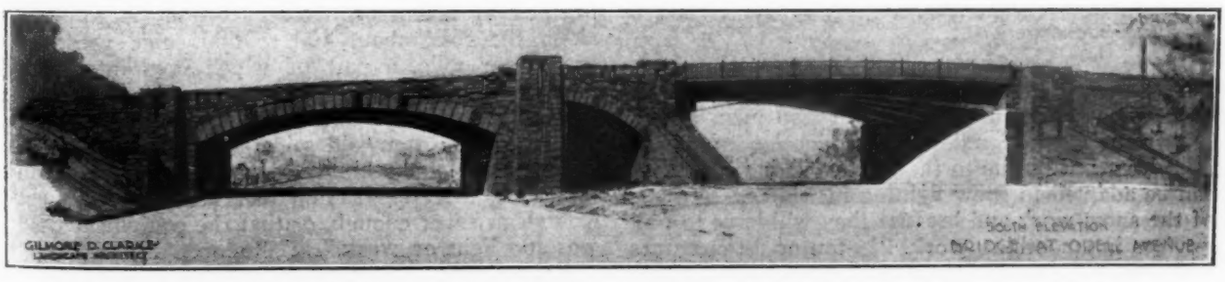


FIG. 7—GRADE CROSSING ELIMINATION STRUCTURE FOR SAW MILL RIVER PARKWAY, YONKERS
Note steel rigid frame span over railroad tracks

to 6,895 as the average daily traffic on the heaviest travelled road. The average traffic on pavements is about 2,103 vehicles per day and on bituminous treated roads 1,274 per day. "From a rather careful analysis we have arrived at a figure of 580 per day as the economic limit of traffic on our untreated gravel roads, but we are actually carrying an average of 630."

Wheelbarrow patrol was used during the days of horse-drawn, steel-tired traffic; followed by team patrol, gang patrol, and tractor and truck patrols.

TEAM PATROL.

The team patrol is undoubtedly the most practical up to an average daily traffic of about 300 vehicles and is "the one and only all-purpose maintenance unit which is able to perform all necessary operations without supplementary help. This unit is most efficient on sections not over six miles long. The team patrol must be equipped with a wagon for hauling material, slip-scraper and hand tools for cleaning drainage lines, mower and scythe for cutting brush and vegetation, and a blade grader or machine for smoothing the road surface. Originally the team patrols were equipped with drags of the split log type, but these soon developed into planers of various designs and then to light graders. The weight of the graders has increased with the increase in traffic."

Team patrol may not be the most economical for each particular operation, as for smoothing the surfacing, cutting weeds, etc.; but to use the special equipment most economical for each of these would mean a much more elaborate organization with consequent additional expense; and as the team patrol alone can do all the different kinds of work required, it is the most economical unit up to the limit of its capacity. Probably one of the most wasteful features of team patrol is the time lost in going to and from work and in making necessary periodic trips over the section.

As the volume of traffic increases it becomes necessary to supplement the team patrol with tractors, tractor patrols or trucks, or even with special work gangs or crews. Also the work becomes more hazardous for the team patrol as the speed of traffic increases. On many roads in Minnesota the point has been reached where the team patrol should be discontinued entirely. Sudden changes, however, have been avoided, partly out of consideration for the patrolmen, but more particularly because of the rapid developments which are taking place in equipment. We do not purchase large quantities of any one type of equipment at any one time, and therefore are able to take on the newer developments without suddenly finding that we have on hand a large amount of obsolete equipment which has not been fully charged off.

TRUCK PATROL.

The present tendency is to replace team patrols with truck patrols and a crew of two men, covering from 20 to 25 miles. The adoption of trucks is at least partly due to the facility with which they can be adapted to snow fighting in winter. Because of the snow work and because they will have to pull graders in smoothing work, 2½-ton or 3-ton trucks with heavy duty-motors are preferred. They should have pneumatic tires and be capable of operating economically at both low speed and up to 25 miles per hour. The grader should be of about 5,000 pounds weight with a 10-foot or a 12-foot blade and mounted on rubber-tired wheels with roller bearings. A spring blade under the truck is very useful but will not take the place of the blade machine. The dump body on the truck should be equipped with power hoist and should be rather wide in order to be as low as possible to make the loading easier by hand shovelling. (It pays to make the work easy for the men.) Such a unit will serve equally well on the higher-type paved roads and a radical change of equipment will not be necessary when the traffic or type of road changes.

In some cases it will be necessary to supplement the truck patrol with special gangs or equipment to perform special work. A tractor or power patrol machine will be very useful at times and a limited number should be available to supplement the work of the truck patrols when they are too busy hauling material. A scarifier also is necessary on any secondary-type road. A scarifier attachment on the grader pulled by the truck may serve, but it will generally be found to require a tractor for pulling power. On gravel roads the combination grader and scarifier is generally found the most practical.

REGRAVELLING SURFACES.

Surface material on a gravel road is being thrown off or worn out by traffic at the rate of from one-quarter to one-half cubic yard per year per mile per average daily vehicle, and must be replaced. Except on light-traffic roads, the patrol is not able fully to replace this loss without help and it is economical to supplement patrol work at intervals of two or three years with a truck fleet, which naturally can be organized to deliver gravel for less cost than the single patrol unit.

In regravelling, the Minnesota practice is to deposit the new material in windrows either at one side or in the center of the road, and immediately spread it out with a blade machine, blading it entirely across the road and windrowing on the opposite side of the road all except a thin floating surface. This operation mixes the material thoroughly and gives a uniform product to work with. The material in this windrow is then gradually fed onto the road surface with the smoothing machine, maintaining on the road a thin film of floating material, which is essential in holding a satisfactory surface. Frequent blading is necessary to keep this film in place, and as the volume of traffic increases, so must the frequency of blading. This method of applying the surfacing material avoids the danger of accidents caused by fast-moving vehicles suddenly striking loose and deep material. The general practice in Minnesota in regravelling is to place along the road about 400 to 600 cubic yards of gravel per mile, a part of which goes into stock piles, but most into windrows.

Referring to rythmic corrugations or "chatter bumps" Mr. Rosenwald said that he did not "consider them as anything serious but merely as an indication that the blading had not been frequent enough or sever enough, or that the equipment used was too light or weak."

Effort is made to maintain as flat a crown as possible with a view to safety to traffic and to avoid

concentrated travel in one track. A crown of not more than 6 inches in 30 feet width of roadway is preferred. All surface material is screened through openings ¾-inch square or 1 inch round, and gravel or stone of large size is rejected.

SURFACE TREATMENT

As the volume of traffic increases, the increasing amount of dust becomes dangerous to traffic as well as necessitating early renewal of material. "With an average daily traffic of 500 vehicles it is usually found that the saving alone of surfacing material will pay for special treatment."

On roads which are soon to receive a better class of pavement, calcium chloride treatments are a great help in keeping down the dust; but where there is no probability of paving for many years to come, but the traffic is becoming too great for the untreated gravel, the state now is rapidly extending bituminous treatments, using both tar and oil. Experiment in the use of these began in 1924, and by the end of 1927 there were 387 miles of bituminous treated roads. Definite methods of treatment have been established but experimental work has not been stopped but is continued along the lines of maintenance and construction. Gravel roads in Minnesota consist of a thin crust of gravel and clay and not a consolidated or water-bound macadam 6 inches to two feet thick, as is found in some other states. Therefore practice in Minnesota does not necessarily conform to that elsewhere.

The Minnesota method is as follows: The road is first bladed smooth and true to cross section, using either a heavy tractor and a 12-foot blade or a rather heavy motor-driven patrol grader, preferably the former. The loose gravel and cover material is windrowed then along the shoulder of the road. The roadway is not swept but the bituminous material is applied directly on the grade as bladed. Half of the roadway is treated at one time to afford room for the traffic with minimum inconvenience. An eight-foot width of oil or tar immediately next to the windrow of gravel is applied at the rate of 0.3 to 0.5 gallon per square yard. One or two miles of roadway is covered in this manner, a power patrol preceding the distributor to blade off as much of the loose material as possible. The prime coat is applied at a temperature of 135° to 150°. Then a four-foot to eight-foot width is applied adjacent to this strip, depending upon the width of the roadway to be treated. This half of the road is allowed to set as the tar or oil penetrates into the roadbed, which requires from one to ten hours. Then the second half of the road is treated in a similar manner while traffic is carried on the side first treated, the weak spots being brought out by traffic and patched up before the seal coat is applied.

When the second side has set sufficiently to carry traffic without picking up, the second or seal coat is applied. Again starting next to the windrow of gravel, an eight-foot width of oil is applied at the rate of 0.3 gallon per square yards at a temperature of 125°, immediately following which a power patrol equipped with rubber tires pulls the gravel over this application, spreading the material about one to one and a half inches deep. A seal coat is applied over the entire surface and as soon as the gravel has been spread the roadway is ready to carry traffic without picking up. Traffic does the work of binding the metal into the road, but a smoothing machine, preferably a power patrol or blade grader, goes over the road continually for three or four days to insure a smooth riding surface.

As soon as the tar or cut-back asphalt "sets up," blading is discontinued, but any weak spots which develop are immediately patched with pre-mixed material, using the same kind of tar or oil and gravel as that used in the treatment. If waviness develops after the tar or oil has set up, the corrugations can be removed by cutting the ridges with a large blade; which operation should be performed on a hot day, and the blade set to secure a shaving action.

This improvement costs about $1500 to $1800 per mile the first year and about half that amount the second year, while in many cases the third year does not require any treatment. Such a road can be scarified and reshaped with little cost. One patrol unit can easily patch and maintain 20 miles of such road if the traffic does not exceed 1000 vehicles per day.

TREATING SUBGRADE

In 1925, experiments were made with a view to developing some method of waterproofing gumbo and clay subgrade in order to hold the gravel up and the water out. It was hoped that in this way gravel consumption could be reduced and the road made more serviceable during all seasons of the year. In the case of gumbo roads, even with 1600 yards of gravel, the rains and spring breakup rendered them muddy, sticky, and rutted; sometimes such mudholes have even to be planked to carry the traffic. Applying oil to the gumbo without covering with gravel did not prove successful, but in 1926 the department had developed a method which has proved satisfactory. This method of treatment is as follows:

The newly graded roadway to be treated is first allowed to take traffic for some time, thereby bringing out the weak spots in the road. These defective areas or pockets of ununiform material are filled with the prevailing clay or gumbo, and the roadway subjected to concentrated blading to develop a very smooth surface. This is soon secured, owing to the inherent ability of this class of soil to pack and harden. Meantime, gravel has been windrowed along one shoulder of the road at the rate of 350 to 450 cubic yards to the mile.

After the road has been shaped and is perfectly dry, the application of oil is started. Half the roadway is treated first with a prime coat of as much oil as the material will absorb, which is usually between 0.35 and 0.55 gallon per square yard; this being applied at a temperature of 175° to 200° with a power distributor. When this oil has soaked in so that it will not pick up, traffic is allowed to use this side of the road and the prime coat is applied to the other side.

After the entire roadway has received the prime coat and when it is dry, a seal coat is applied starting on the side of the road first primed, which is also the side on which the gravel is windrowed. The application of the seal coat can be at a temperature as low as 160°, and at the rate of 0.3 to 0.35 gallon per square yard. Within half an hour a power

patrol equipped with rubber tires and a 12-foot blade pulls the gravel over onto the oiled surface. The entire surface is covered in this manner and the roadway is then ready for traffic. A thin layer of gravel is kept floating over this treatment and, with the exception of slight discoloration, it exhibits all the characteristics of an untreated good gravel road.

Maintenance, consisting of blading and planing, is started at once and carried on consistently. Spring blades mounted on trucks are found very satisfactory on these roads, although power patrols are sometimes used. During the second year the roadway is bladed free from loose material and a light application of the same kind of oil used the first year is applied at the rate of 0.2 to 0.3 gallon per square yard, which is covered with a thin coat of gravel about 125 to 150 yards to the mile. Wherever there may be break-ups or extreme roughness, a light scarifying will remedy the difficulty with little additional cost. The cost of this treatment ranges between $1200 and $1800 per mile the first year, and half that amount the second year. It is usually, but not always, advisable to repeat the second year's treatment the third year.

"The secondary type of road must take up the slack between the primitive roads and the final paved roads, and it is undoubtedly the best policy to maintain a road in this class until it is possible to construct it actually on the best location and actually laid out with a view to future developments."

Road Construction in 1927

Figures from county officials showing amounts spent on highway work in each county in 1927, miles of each kind of road surface built that year, and total in use at the end of the year. Also the widths of the improved roads

Through the cooperation of engineers, surveyors and other highway officials of counties in all parts of the country, Public Works presents its annual survey and review of county highway work. To those who furnished data, Public Works extends its thanks; and it is hoped that the information presented with their help will be of value and assistance to everyone engaged in this large and important field of engineering.

Within the limits of the space available, an attempt has been made to gather data of most value in showing the present day trends of practice. In this issue are shown the total amount spent last year, the amount spent on maintenance, and the total available for 1928; the amount, kind and width of improved roads built last year; certain details in regard to width of roadway, bridges and culverts; and notes regarding the use of dust layers. In a forthcoming issue will be presented a large amount of data regarding methods of gang and patrol maintenance, mileage covered and equipment used; and also information regarding the use of motor trucks, tractors, graders, maintainers and other equipment generally used by counties.

Money Spent in 1927 and Available for 1928

State and County	Total Spent in 1927	Spent on Maintenance	Available for 1928
Alabama:			
Jackson	$60,000	$30,000	$60,000
Madison	150,000	40,000	150,000
Randolph	60,000	40,000	60,000
Tallapoosa	125,000	40,000	310,000a
Arkansas:			
Hot Spring	45,000	5,000	30,000
Marion	25,000	5,000	27,500
Pike	16,000	.....	17,500
California:			
Alameda	967,056	242,233	750,000
Fresno	400,000	b	c
Siskiyou	196,967	91,485	200,000
Solano	175,000	.....	c
Colorado:			
Lake	20,536	20536	c
Florida:			
Monroe	1,000,000	40,000	200,000
Palm Beach	841,681	96,907	566,804
Pinellas	.....	200,000	260,000
St. Lucie	335,000	114,000	210,000
Santa Rose	85,000	65,000	175,000
Georgia:			
Cherokee	70,000	35,000	74,000
Clarke	150,000	10,000	150,000
Telfair	100,000	30,000	160,000
Wilcox	21,741	16,441	20,000
Idaho:			
Bonner	78,674	30,093	128,000
Cannon	135,592	114,612	124,423
Clearwater	18,361	1,300	62,000
Kootenai	30,014	10,014	30,000
Madison	10,000	10,000	14,000
Shoshone	262,477	86,042	285,320

State and County	Total Spent in 1927	Spent on Maintenance	Available for 1928
Illinois:			
Bond	10,000	10,000	15,000
Carroll	60,000	15,000	50,000
Christian	43,000	32,000	43,000
Crawford	24,996	16,653	30,000
Fulton	220,000	100,000	300,000
Iroquois	360,000	102,092	85,000d
Jasper	15,000	5,000	12,500
Kane	280,000	20,000	250,000
Kankakee	112,033	8,049	85,000
Lake	600,000	60,000	100,000
Macoupin	60,000	20,000	20,000
Marion	13,000	3,000	27,000
Mason	110,000	66,000	f
McDonough	37,000	17,600	34,000
McHenry	204,000	204,000	208,000
McLean	87,000	67,000	88,000
Monroe	70,000	50,000	70,000
Peoria	168,000	78,000	529,000
Richland	65,000	20,000	74,000
Sangamon	97,000	85,000	350,000
White	118,300	8,000	152,200e
Whiteside	83,000	17,489	75,000
Will	150,000	100,000	150,000
Williamson	37,000	37,000	500,000
Woodford	150,000	37,500	150,000
Indiana:			
Delaware	120,000	120,000	110,000
Jay	74,000	.....	77,000
Jefferson	44,039	.....	41,000
Martin	22,000	.....	28,000
Newton	118,000	72,000	125,000
Rush	80,000	50,000	100,000
Shelby	82,428	51,394	85,000
Wayne	160,000	160,000	110,000

Money Spent in 1927 and Available for 1928

State and County	Total Spent in 1927	Spent on Maintenance	Available for 1928
Iowa:			
Black Hawk	104,597	19,591	66,250
Butler	143,795	42,848	135,000
Calhoun	114,954	32,055	115,000
Carroll	226,173	86,444	f
Cass	33,670	26,961	55,000
Cherokee	49,596	19,056	50,000
Cerro Gordo	250,000	80,000	200,000
Clay	72,412	52,089	60,000
Chickasaw	47,308	23,720	51,000
Decatur	42,871	18,000	45,000
Delaware	75,000	25,000	65,000
Des Moines	39,894	31,283	f
Dubuque	175,000	87,500	130,000
Emmett	130,069	50,540	c
Fayette	77,679	32,883	80,000
Floyd	49,093	15,038	.....
Fremont	34,473	33,097	f
Greene	87,000	32,000	50,000
Grundy	51,438	10,405	85,000
Guthrie	170,000	60,000	180,000
Hamilton	64,590	40,536	80,000
Harrison	61,458	29,689	50,000
Ida	45,995	22,711	.....
Jackson	45,000	32,000	f
Jones	87,000	35,000	55,000
Keokuk	78,349	37,700	45,000
Kossuth	240,000	80,000	160,000
Louisa	30,000	23,000	48,000
Madison	42,455	23,669	37,000
Marion	63,631	42,265	49,516
Mills	80,000	30,000	400,000
Monona	69,679	31,490	77,000
Muscatine	214,968	39,099	150,000
O'Brien	150,000	33,000	150,000
Osceola	115,000	40,000	60,000
Page	63,110	60,000	55,000
Palo Alto	265,000	105,000	550,000
Pocahontas	208,169	83,602	175,000
Sac	76,237	48,563	70,000
Scott	69,418g	42,000	70,000
Shelby	23,236	23,236	.....
Sioux	169,772	36,506	136,000
Taylor	53,000	40,000	45,000
Kansas:			
Allen	293,223	39,310	290,000
Anderson	107,336	29,048	100,000
Bourbon	166,600	100,000	.....
Brown	378,550	132,936	210,000
Chase	40,000	16,000	175,000
Chautauqua	137,497	20,453	200,000
Cowley	598,530	244,332	f
Decatur	69,824	29,895	f
Ellis	100,000	35,000	150,000
Geary	145,000	32,000	140,000
Gove	102,229	23,769	65,000
Graham	89,248	17,716	30,000
Harper	87,000	29,750	112,000
Hodgeman	147,000	23,000	105,000
Jackson	93,000	26,000	100,000
Johnson	1,004,153	185,000	375,000
Lyon	300,325	70,000	230,000
Marshall	175,000	70,000	225,000
Miami	200,000	3,000	20,000
Morton	34,000	9,000	36,000
Nemaha	152,000	35,000	142,000
Neosho	200,000	40,000	550,000
Osage	220,000	69,000	175,000
Osborne	150,000	45,000	150,000
Pawnee	70,000	20,000	100,000
Phillips	215,967	64,309	150,000
Pratt	145,277	35,000	f
Rawlins	97,000	19,000	123,000
Reno	250,000	120,000	400,000
Riley	340,860	100,000	300,000
Sedgewick	322,387	242,874	f
Shawnee	164,541	129,525	170,000
Sheridan	92,598	30,000	50,000
Wichita	52,619	10,408	50,000
Woodson	131,550	84,422	256,000
Kentucky:			
Boyle	80,000	20,000	70,000
Campbell	160,086	130,017	132,000
Scott	68,215	40,000	150,000
Shelby	89,654	51,249	57,000
Louisiana:			
Beauregard	82,000	54,000	120,000
Livingston	75,000	8,000	9,000
Rapides	100,000	60,000	f
Richmond	30,000	30,000	f
Maryland			
Baltimore	1,216,850	332,000	1,288,455
Caroline	47,694	47,694	f
Garrett	110,000	50,000	60,000
Kent	25,000	15,000	70,000
St. Marys	310,000a	95,000	195,000

State and County	Total Spent in 1927	Spent on Maintenance	Available for 1928
Massachusetts:			
Essex	251,093	78,729	267,250
Franklin	66,986	.....	.....
Norfolk	121,545	.....	125,000
Michigan:			
Allegan	229,910	41,000	225,000
Calhoun	397,000	110,000	300,000
Cass	97,850	20,000	97,850
Chippewa	180,000	80,000	190,000
Emmett	144,257	46,000	100,000
Genesee	1,248,859	279,076	1,500,000
Gogebic	215,997	86,180a	151,000
Houghton	214,300	149,500	500,000
Ionia	300,000	120,000	250,000
Jackson	500,000	207,000	500,000
Kalamazoo	511,000	184,000	530,000
Kent	905,445	278,779	700,000
Leelanau	116,709	50,993	198,665
Macomb	2,134,509	176,634	.....
Mason	88,000	29,925	85,000
Schoolcraft	150,000	125,000	250,000
Minnesota:			
Aitkin	110,000	13,259	115,000
Benton	70,000	15,000	60,000
Blue Earth	155,000	67,000	160,000
Brown	98,393	43,472	105,000
Carlton	115,659	29,046	100,000
Chippewa	68,410	18,705	60,000
Cottonwood	90,000	40,000	90,000
Chisago	159,106	73,582	110,000
Crow Wing	121,883	38,626	115,500
Dakota	172,079	29,854	100,000
Douglas	145,805	13,834	59,063
Faribault	208,409	76,068	160,000
Goodhue	325,887	39,359	325,000
Grant	83,888	14,415	60,000
Hubbard	24,000	12,000	37,000
Jackson	151,375	49,997	146,886
Kandiyohi	120,000	25,000	120,000
Kittson	76,909	27,429	56,000
Lac qui Parle	120,147	34,944	132,348
Lake	90,613	20,000	80,000
Le Sueur	160,000	38,000	160,000
Lincoln	140,870	33,526	60,000
Lyon	142,481	82,864	120,000
Mahnomen	33,000	7,500	30,000
Marshall	163,149	39,813	75,000
Martin	150,000	45,000	85,000
MacLeod	120,000	43,000	125,000
Meeker	160,000	30,000	130,000
Morrison	72,473	29,172	75,000
Mower	170,045	30,378	175,000
Olmsted	100,000	50,000	135,000
Otter Tail	268,000	52,585	193,000
Pennington	50,003	12,473	55,000
Pipestone	77,094	30,869	60,000
Polk	241,949	28,833	240,000
Red Lake	48,388	18,278	50,000
Redwood	168,798	47,442	148,000
Rock	44,208	19,302	50,000
Roseau	59,961	14,833	56,884
St. Louis	1,999,000	999,500	2,200,000
Scott	144,589	28,961	120,000
Sibley	136,387	34,001	116,000
Stearns	125,000	28,000	175,000
Steele	87,704	42,899	89,000
Stevens	43,522	14,238	93,000
Swift	143,652	21,600	80,000
Wadena	63,648	20,000	60,000
Washington	80,000	25,000	100,000
Waseca	145,112	22,085	140,000
Watonwan	135,000	25,000	105,000
Wilkin	95,235	15,849	85,000
Wright	190,000	30,000	145,000
Mississippi:			
Smith	125,000	.....	285,000h
Missouri:			
Barry	74,731	74,731	f
Clinton	62,144	none	c
Callaway	42,440	18,281	.....
Cooper	50,000	50,000	f
Holt	97,000	40,000	95,000
Lincoln	57,677	29,800	63,500
Miller	45,654	45,000	46,000
Monroe	46,000	16,000	35,000
Stone	40,000	20,000	40,000
Vernon	30,000	.....	.....
Montana:			
Blaine	60,000	35,000	60,000
Dawson	85,891	40,563	80,000
Havre	35,000	17,500	50,000
Judith Basin	57,353	7,663	60,000
Lincoln	37,536	37,260	.....
Missoula	78,469	26,518	80,000
Musselshell	28,500	28,500	35,000

Money Spent in 1927 and Available for 1928

State and County	Total Spent in 1927	Spent on Maintenance	Available for 1928
Montana (Continued)			
Phillips	67,336	42,939	f
Rosebud	52,780	21,000	50,000
Sanders	54,000	26,000	50,000
Nebraska:			
Brown	31,281	12,190	25,000
Clay	40,000	15,000	40,000
Hall	48,010	22,955	.....
Johnson	80,000	6,000	70,000
Orleans	60,000	3,000	53,000
Richardson	72,031	43,243	60,000
Saunders	178,942	42,222	.....
Thayer	40,868	8,085	42,000
Valley	20,000	1,500	15,000
New Jersey:			
Mercer	751,171	232,570	490,000
Morris	425,312	230,000	700,000
Union	.....	222,992	241,992
New Mexico:			
Colfax	62,000	51,000	60,000
Luna	8,000	2,600	8,000
New York:			
Albany	330,186	75,000	350,000
Cayuga	428,759	60,000	f
Chautauqua	758,647	53,553	f
Herkimer	1,544,871	50,288	1,710,519
Jefferson	600,000	200,000	800,000
Madison	285,000	150,000	300,000
Niagara	845,623	120,000	425,000
Orleans	184,070	14,222	190,000
Oswego	700,000	86,000	700,000
Suffolk	1,411,880	754,614	2,768,960
Westchester	1,550,000	none	1,950,000
North Carolina:			
Beaufort	56,200	38,200	59,000
Carteret	1,500,000	.....	300,000
Columbus	75,000	25,000	.....
Cumberland	92,174	46,386	82,170
Iredell	150,000	90,000	160,000
Johnston	190,000	160,000	200,000
Mecklenburg	375,000	.....	375,000
Montgomery	38,000	35,000	42,000
Moore	60,000	45,000	60,000
Nash	110,000	30,000	33,000
Pitt	120,000	80,000	120,000
Robeson	129,375	62,070	f
Wayne	.....	.....	111,000
North Dakota:			
Barnes	76,768	18,000	64,000
La Moure	200,000	100,000	i
Mountrail	60,000	15,000	70,000
Traill	60,000	20,000	60,000
Walsh	30,000	5,000	30,000
Williams	53,049	26,845	60,000
Ohio:			
Auglaize	80,000	60,000	80,000
Carroll	110,000	10,000	120,000
Darke	125,000	100,000	100,000
Delaware	348,417	110,250	450,000
Fayette	65,000	65,000	70,000
Geauga	500,000	50,000	800,000
Hamilton	1,491,000	300,000	f
Harrison	130,000	25,000	95,000
Jefferson	350,000	140,000	350,000
Knox	331,706	67,871	350,000
Lorain	600,000	190,000	550,000
Miami	200,000	100,000	500,000
Noble	50,000	35,000	35,000
Pickaway	60,000	60,000	75,000
Preble	67,457	.....	84,321
Putnam	360,000	173,690	976,000
Ross	42,000	38,000	45,000
Tuscarawas	456,887	97,381	500,000
Union	190,000	90,000	120,000
Washington	120,000	40,000	100,000
Williams	110,000	80,000	140,000
Wood	670,300	150,400	700,000
Wyandotte	260,000	100,448	200,000
Oklahoma:			
Kay	400,000	120,000	300,000
Oregon:			
Douglas	392,162	50,000	270,000
Gilliam	45,000	45,000	80,000
Jackson	288,222	62,138	230,000
Klamath	75,000	50,000	250,000
Linn	438,029	.....	400,000
Malheur	60,000	35,000	60,000
Yamhill	138,406	7,979	150,000
Pennsylvania:			
Berks	2,632,521	.....	350,000
Huntingdon	56,155	16,254	35,000
Snyder	.....	.....	35,000
Somerset	412,322	50,000	175,684
South Carolina:			
Darlington	95,000	37,000	99,875
Greenwood	285,000	48,000	850,000
Orangeburg	125,000	31,250	108,000
South Dakota:			
Beadle	127,462	69,542	145,000
Day	100,500	28,000	65,000
Douglas	22,500	7,000	27,000
Gregory	53,006	21,984	40,000
Haakon	84,753	15,147	.....
Harding	20,000	15,000	20,000
Hyde	4,000	2,000	15,000
Lake	62,713	9,834	f
Lawrence	68,992	20,000	65,000
Marshall	61,997	31,473	f
Pennington	183,000	54,000	170,000
Perkins	135,000	26,469	65,000
Potter	48,907	5,721	.....
Spink	75,000	37,500	75,000
Union	139,151	35,648	120,000
Yankton	120,000	20,000	150,000
Tennessee:			
Dickson	20,000	6,000	.....
Giles	10,000	6,000	8,000
Hardeman	18,000	8,500	20,000
Henry	70,000	20,000	70,000
Hickman	25,000	10,000	20,000
Loudon	75,000	b	200,000
Montgomery	58,000	58,000	70,000
Obion	180,000	45,000	150,000
Robertson	45,000	45,000	60,000
Texas:			
Anderson	485,000	20,000	150,000
Atascosa	100,000	10,000	600,000
Cameron	2,000,000	50,000	1,000,000
Camp	65,000	5,000	100,000
El Paso	515,000	180,000	2,600,000
Hays	36,000	25,000	86,000
Henderson	none	.....	500,000
Webb	325,114	none	598,000
Virginia:			
Augusta	210,000	110,000	170,000
Northumberland	37,145	60%	36,970
Washington:			
Clallam	190,614	40,000	192,000
Franklin	126,000	42,000	140,000
Lincoln	194,000	55,000	200,000
Mason	77,768	67,113	70,000
Pend Oreille	83,926	44,327	85,211
Skamania	70,000	3,500	70,000
West Virginia:			
Brooke	113,407	53,000	115,000
Cabell	200,000	100,000	300,000
Calhoun	60,000	40,000	50,000
Mercer	163,000	40,000	313,000
Mineral	60,000	60,000	160,000
Roane	85,000	50,000	150,000
Tyler	263,626	40,000	118,000
Wayne	170,000	50,000	125,000
Wyoming	600,000	100,000	400,000
Wisconsin:			
Adams	112,059	49,968	.....
Bayfield	169,781	70,622	170,000
Calumet	131,167	69,380	258,778
Dane	1,796,179	369,437	1,500,000
Dodge	808,213	118,567	910,342
Douglas	278,833	118,638	225,000
Dunn	485,439	92,303	200,000
Fon du Lac	587,128	150,009	601,000
Grant	439,133	158,149	419,760
Green Lake	160,000	65,000	160,000
Iowa	260,000	80,000	95,000
Jackson	222,984	83,032	311,437
Juneau	247,333	107,500	f
La Crosse	329,848	95,819	316,998
Milwaukee	757,000	181,349	f
Monroe	339,803	147,722	350,000
Pierce	234,000	122,000	240,000
Sauk	325,000	130,000	370,000
Sheboygan	395,622	103,368	483,000
Vernon	394,669	105,919	450,000
Washington	145,000	50,000	295,000
Waukesha	535,410	95,751	543,000
Waushara	168,500	60,000	f
Wyoming:			
Campbell	54,398	2,322	35,000
Natrona	121,693	38,693	75,000
Sheridan	79,625k	25,000	45,000

a—State and County combined; b—practically all; c—not yet decided; d—maintenance only; e—if bond issue passes; f—about the same as 1927; g—not including bridges; h—bonds have been sold for this amount; i—a little more than in 1927; k—includes sinking fund and interest.

Graded Roads

State and County	Built in 1927	Miles in County End of 1927	Width of Improved Surface
Alabama:			
Jackson	15	175	....
Randolph	....	50	24
Tallapoosa	35	....	....
Arkansas:			
Hot Spring	200	650	20
Marion	100	150	18
California:			
Fresno	....	3,000	16
Marin	34.5	....	....
Siskiyou	....	328.5	....
Florida:			
Palm Beach	32	50	18
St. Lucie	12	111	30
Santa Rosa	8	....	....
Georgia:			
Cherokee	7	1,200	26
Clarke	....	50	....
Telfair	10	350	26
Idaho:			
Bonner	....	1,200	16
Clearwater	....	144	....
Kootenai	3	301	16
Shoshone	11	151	....
Illinois:			
Bond	100	....	....
Carroll	12	50	30
Fulton	200	....	24
Jasper	80	160	24
Lake	10	110	18-30
Maconpin	270	270	24
Marion	420	1,200	....
McHenry	....	250	....
McLean	160	312	30
Sangamon	150	1,560	24-28
Woodford	2	....	24
Indiana:			
Delaware	17	615	24
Jefferson	....	292	....
Kosciusko	....	287	....
Newton	....	273	....
Iowa:			
Black Hawk	14.6	60	26
Butler	....	20	26
Calhoun	134	615	26
Carroll	35	95	26
Cass	0.5	1.5	24
Cherokee	5.75	49.5	24-26
Cerro Gordo	10	84	....
Clay	45	550	20-26
Chickasaw	9	14	28
Dubuque	4	....	26
Delaware	12	50	26
Emmett	35	10.2	22
Fayette	76	141	26
Floyd	11	12	26
Greene	75	400	24
Grundy	19.5	68.5	26
Guthrie	12	20	24
Hamilton	13.7	16.7	26
Harrison	16	54	28
Howard	10	36	26
Ida	3.3	63.3	24
Keokuk	4	6.2	28
Kossuth	34	610	22-30
Marion	6	6	24
Muscatine	12	9.7	26
O'Brien	19.5	114	26
Page	1.2	2.5	28
Palo Alto	3	3	24
Pocohontas	15	745	26
Sac	50	872	24
Scott	30	55	28
Shelby	16	50	28
Sioux	24.5	67.5	26
Taylor	....	157	26
Kansas:			
Allen	4	51.7	....
Anderson	10	80	28
Brown	28	128	28
Chase	7	576	30
Chautauqua	7	10	30
Cowley	20	2,002	20-30
Ellis	35	1,100	30
Gove	35	1,168	....
Graham	100	220	40
Geary	10	30	28
Harper	7.5	7.5	28
Hodgeman	16	16	28-30
Jackson	....	34	30
Johnson	7	7	28
Lyon	25	145	28
Kansas (Continued)			
Marshall	7	9	28-30
Miami	10	18	30
Morton	15	130	28
Neosho	20	75	28
Osage	....	19	....
Osborne	11	32	28
Phillips	34	1,938	30
Pratt	40	326.7	24-30
Rawlins	83	1,561	26-30
Reno	30	570	28
Sedgwick	11	216	30
Shawnee	5	117.9	26
Sheridan	23	1,961	30
Wichita	43	268.5	....
Kentucky:			
Boyle	10	20	....
Campbell	3.5	....	....
Louisiana:			
Beauregard	12	775	18
Livingston	20	....	....
Rapides	43	650	24
Richmond	160	....	....
Maryland:			
Garrett	....	60	16
Kent	....	365	....
Michigan:			
Emmet	7.4	209.7	9-20
Genesee	16.5	....	36
Gogebic	8	8	24
Ludington	5	....	....
Minnesota:			
Aitkin	32	151	24
Benton	8	23.6	24
Brown	11	....	24
Carlton	....	15	24
Chippewa	9	20	24
Chisago	12	220	24
Dakota	....	3.3	30
Douglas	13	18.2	....
Faribault	39.5	336	22-26
Jackson	18	176	24
Kandiyohi	25	240	24-26
Kittson	8	83	24
Lac qui Parle	12.8	31.4	24
Lake	10	400	18-30
Le Sueur	17	270	24
Lincoln	22.5	140	24
Mahnomen	5	100	18-24
Marshall	29	242	24
Martin	14	182.8	24
McLeod	12.7	864.8	24-30
Meeker	20	152	24
Morrison	10	126	24
Olmsted	...	50	24
Ottertail	24	...	...
Pennington	10	127.5	24
Pipestone	2	2	24
Polk	31.5	100.7	24
Red Lake	7	38.8	24
Redwood	6.3	213.3	24
Roseau	8.7	35.2	24
St. Louis	73	946	24-30
Scott	16	...	...
Sibley	12	12	24
Stearns	125	...	20-24
Steele	7.5	...	24
Swift	13	22	24
Waseca	18.5	18.5	24
Watonwan	23	500	24
Wilkin	9.2	29.5	24
Wright	33	215	24
Mississippi:			
Smith	100	...	16
Missouri:			
Holt	25	75	24
Lincoln	125	840	10-16
Monroe	15	...	...
Montana:			
Blaine	20	605	22
Dawson	61	611	22-24
Havre	100	500	22
Judith Basin	69	...	24
Lincoln	...	1.5	16-20
Missoula	11	738	18
Musselshell	...	450	18-22
Phillips	70	600	20
Rosebud	102	720	26-30
Sanders	3	706	16
Nebraska:			
Brown	100	550	20
Clay	60	800	24-26
Hall	...	59	16-24
Johnson	90	240	24
Orleans	71	180	24

Graded Roads

State and County	Built in 1927	Miles in County End of 1927	Width of Improved Surface
Nebraska (Continued)			
Richardson	12	142	24
Saunders	350	1,350	24
Thayer	31	114	24
Valley	12	138	24
New Jersey:			
Mercer	...	185	...
New Mexido:			
Colfax	20	...	...
New York:			
Herkimer	10.2	...	...
North Carolina:			
Beaufort	12	5,832	...
Cartaret	...	16	...
Mecklenburg	...	217.8	...
Moore	100	650	30
Pitt	21	160	30
Robeson	40	1,500	...
Wayne	75	1,000	...
North Dakota:			
Barnes	110	375	22
La Moure	100	400	16
Mountrail	115	460	24
Traill	12	117	24
Walsh	48	48	20
Williams	52	850	24
Ohio:			
Carroll	18	...	16
Delaware	...	17.7	9-16
Harrison	7	...	...
Jefferson	9	810	16
Noble	4	...	...
Preble	14	...	20
Ross	12	...	16
Tuscarawas	6	744.5	22
Washington	6	...	...
Williams	12	100	10
Wood	...	418	...
Oklahoma:			
Kay	11	...	36
Oregon:			
Donglas	10	268.7	16
Gilliam	...	500	...
Jackson	20	...	20
Klamath	10	100	22-26
Linn	15	822	12-18
Malheur	20	6,000	14
Yamhill	4	...	...
South Carolina:			
Darlington	52.9	1,200	20
Greenwood	25	1,400	22-30
South Dakota:			
Beadle	8.6	337.5	24
Day	128	369	20-24
Douglas	25	198	24
Gregory	31	491	...
Haakon	42	422	18-24
Harding	15	470	24
Hyde	9	300	24
Lake	34	...	24
Lawrence	20	327	24
Marshall	46	200	24
Pennington	20	360	24
Perkins	200	700	18-24
Potter	41	230	24
Spink	20	...	20
Union	43	362	20-24
Yankton	25	25	24
Tennessee:			
Dickson	100	...	16-30
Giles	...	10	14
Henry	40	540	32
Loudon	...	175	18
Montgomery	160	560	16
Obion	34	80	24
Robertson	400	600	...
Texas:			
Anderson	8	14	...
Atascosa	200	1,060	...
Cameron	200	700	30
Camp	5	300	26
El Paso	...	65	4-30
Hays	27	...	30
Webb	12.4	...	30
Virginia:			
Augusta	10	...	20
Washington:			
Clallam	28	500	16-22
Franklin	4	735	...
Lincoln	50	2,600	24
Pend Oreille	2.5	...	16
West Virginia:			
Brooke	7.5	...	24
Cabell	5	...	...
Calhoun	2	20	14-18
Mercer	10	601	14-30
Roane	2	40	16-20
Tyler	8.5	12.5	26
Wayne	10	300	18-26
Wyoming	60	175	22-26
Wisconsin:			
Adams	25.6	...	24
Bayfield	19	254	24
Calumet	2	...	...
Dodge	23	...	26
Douglas	27.7	243	24
Dunn	48	...	24
Fond du Lac	2.5	...	...
Green Lake	12	250	12-18
Iowa	75	...	...
Jackson	15	...	...
Juneau	3.4	340	18
La Crosse	42	...	...
Monroe	110	...	...
Polk	46	...	26
Sauk	15	350	24
Vernon	28	...	...
Washington	24	85	24
Waushara	5	...	...
Wyoming:			
Campbell	84	376.2	20-24
Natrona	138	465	18
Sheridan	19.1	765.6	20

Gravel Roads

State and County	Built in 1927	Miles in County	Width of Improved Surface
Alabama:			
Jackson	15	175	12
Madison	75	1,600	18-24
Arkansas:			
Hot Springs	150	...	...
Marion	75	...	...
California:			
Alameda	...	284	16-24
Fresno	...	75	16
Marin	34.5	235	24
Siskiyou	...	339.7	...
Colorado:			
Lake	2.5	80	18
Florida:			
Pinellas	...	54a	...
Georgia:			
Cherokee	5	...	...
Idaho:			
Bonner	2	25	26
Cannon	50	...	...
Shoshone	5	24	24
Illinois:			
Carroll	8	40	14
Christian	...	2	20
Crawford	15	282	24
Iroquois	7	38	18
Kane	20	45	18
Lake	45	650	8-14
McHenry	150	650	15-24
McLean	10	40	14
White	36	192.5	9
Whiteside	30.2	...	...
Woodford	1	...	16
Indiana:			
Delaware	17	...	...
Kosciusko	17	210	14-18
Martin	3	...	...
Rush	6	...	...
Shelby	25	516	...
Iowa:			
Black Hawk	17.5	64.	0..
Butler	19	130	26
Calhoun	84	410	26
Cherokee	23.7	29.7	24-26
Chickasaw	4	62	...
Clay	22	400	20-26
Delaware	9	50	24
Des Moines	3	...	...
Emmett	32.5	181.2	22-26
Fayette	30	...	20
Floyd	1.5	65.1	26
Greene	40	350	...
Grundy	12.7	45.5	26

Gravel Roads

State and County	Miles Built in 1927	Miles in County	Width of Improved Surface
Iowa (Continued)			
Guthrie	15	40	24
Howard	16	23	26
Ida	9	17	24
Keokuk	2	2	28
Kossuth	42	525	22-30
Madison	3.2	3.2	26
Marion	3	3	24
Muscatine	21.4	31.8	...
O'Brien	8	42	26
Palo Alto	43	257	20
Pocahontas	60T	302.7	20-26
Sac	21	252	24
Scott	6.5	35.3	20
Sioux	30	44.5	26
Kansas:			
Allen	12	33.7	16
Anderson	...	36	...
Brown	45	45	22
Cowley	...	5	...
Ellis	1.5	4	30
Jackson	34	34	30
Lyon	6	23	20
Marshall	0.5	...	...
Neosho	60	100	16
Osborne	...	14	18
Phillips	10	...	...
Shawnee	2	57.2	26
Kentucky:			
Boyle	10	50	...
Louisiana:			
Beauregard	5.7	37	...
Livingston	40	...	9-12
Rapides	5	132	24
Richmond	40	...	...
Maryland:			
St. Marys	9	88.5	15
Michigan:			
Allegan	19	296	12-16
Calhoun	27.3	342	...
Cass	16	230	24
Emmet	21.1	...	...
Genesee	19.5	506	15
Ionia	50	355	24
Jackson	...	387	9
Kent	36.2	328	16
Lapeer	2.5	345	9-16
Leelanau	9.2	109.7	9-16
Livingston	20	300	9-16
Macomb	9.5	179.5	8-16
Mason	3	145	9-15
Minnesota:			
Aitkin	17	...	24
Benton	8	90.6	24
Carlton	...	95	24
Chippewa	5	110.9	24
Chisago	45	340	22
Crow Wing	9	50.6	24
Douglas	17	130.4	...
Faribault	42.1	...	...
Goodhue	37.1	202	24
Hubbard	...	17.5	...
Jackson	20	140	20
Kandiyohi	12	227	...
Kittson	2	31	20
Lac qui Parle	9.8	151.9	24
Lake	12	400	...
Le Sueur	11	223	24
Lincoln	...	117.5	24
Lyon	18.8	216	24
Mahnomen	9	11	24
Marshall	28	183.3	...
Martin	15	167.8	20
McLeod	40.7	...	...
Meeker	13	132	...
Morrison	4	126	...
Mower	45.1	...	...
Olmsted	20	130	22
Otter Tail	120	250	24
Pennington	...	101	...
Pipestone	7	103.2	24
Polk	28.2	118	24
Red Lake	2.4	60.4	24
Redwood	79	211.3	24
Roseau	12.2	43.3	20
St. Louis	27	1,773	24-30
Scott	10	102	26-30
Sibley	51.3	163	20
Stearns	36	...	...
Steele	12	90	22
Swift	...	121	24
Waseca	17.1	141.3	24
Washington	5	73	24
Watonwan	30	248	24
Wilkin	11.8	62.9	24
Wright	55	200	24
Mississippi:			
Smith	20	30	...
Missouri:			
Holt	3.5	...	...
Lincoln	34.5	365	10
Monroe	1	...	...
Montana:			
Judith Basin	17	...	24
Missoula	7.2	74	24
Phillips	4.6	12	22
Rosebud	6	45	...
Sanders	18	...	16
Nebraska:			
Clay	...	65	26
Hall	...	56	...
Richardson	1	1	24
Saunders	2	...	...
Thayer	23	43	24
New York:			
Albany	10	40	14
Cayuga	30	...	...
Niagara	20	58	12-16
North Carolina:			
Johnston	34	1,350	30
Moore	15	...	...
North Dakota:			
Barnes	7	152	...
La Moure	40	60	32
Mountrail	45	45	22
Traill	19	20	24
Williams	7	9	24
Ohio:			
Darke	7	1.150	...
Fayette	4	...	...
Geauga	25	...	10-20
Hamilton	1	...	12
Harrison	18	60.1	12-20
Jefferson	18	210	12
Knox	20	...	...
Miami	5	...	...
Preble	14	165	...
Putnam	15b	745.3	9
Ross	50	...	18
Tuscarawas	30	309	16
Union	8.5	600	12-18
Washington	30	135	14
Williams	10	35	10
Wyandot	4	...	...
Oklahoma:			
Kay	1	1	18
Oregon:			
Douglas	10	755	16
Gilliam	...	42	14
Jackson	1	...	16
Linn	15	822	12-18
Malheur	4	200	16
South Dakota:			
Beadle	33	199	24
Day	23.2	141	...
Douglas	...	32	...
Gregory	4	4	...
Haakon	11	42	24
Lake	9.5	...	24
Lawrence	11	79	18-24
Marshall	14	44	24
Pennington	6	97	24
Union	22	105	23
Yankton	22	125	24
Tennessee:			
Dickson	20	...	...
Henry	50	100	16
Hickman	22	175	20
Loudon	...	70	...
Montgomery	52	400	16
Obion	10	40	...
Robertson	10	150	...
Texas:			
Anderson	24	...	...
Cameron	1	1	...
Hays	27	...	...
Virginia:			
Augusta	4	15	10-12
Washington:			
Clallam	50	500	...
Franklin	15	225	12
Lincoln	35	430	24
Mason	6	...	...
Pend Oreille	2.1	...	20
Skamania	4	...	...
West Virginia:			
Cabell	1	1	24
Tyler	28	46	16
Wayne	51	83	20-26

Gravel Roads

State and County	Miles Built in 1927	Miles in County	Width of Improved Surface
Wisconsin:			
Adams	20.5	...	24
Bayfield	22	115	24
Calumet	8	...	20
Dane	132.4	2,410	18
Dodge	84	349	12
Douglas	10.5	203	28
Dunn	10	...	...
Fond du Lac	35.8	248	24
Grant	120	450	12-24
Green Lake	30	250	9-18
Iowa	15	...	...
Jackson	4	...	...
Juneau	7.2	60	18
La Crosse	44,000rs	...	...
Milwaukee	...	1.5	18
Monroe	10	...	...
Polk	71.5	...	26
Sauk	22	325	18
Sheboygan	25.3	293	24
Vernon	4	...	...
Washington	24	85	20
Waushara	20	...	26
Wyoming:			
Natrona	9	21	18
Sheridan	1	1.8	...

a—shell and rock; r—resurfacing; s—square yards. b—traffic bound. T—township.

Sand-Clay and Top Soil Roads

State and County	Miles Built in 1927	Miles in Use, End of 1927	Width of Improved surface
Alabama:			
Randolph	17.3	...	36
Tallapoosa	25	...	...
Arkansas:			
Hot Springs	250	...	...
Marion	25	...	...
Georgia:			
Cherokee	2	...	...
Clarke	5	100	18
Wilcox	20	400	24
Illinois:			
Crawford	5	8	24
Iowa:			
Carroll	35	91	26
Hamilton	5	115	26
Kansas:			
Ellis	...	6.5	30
Gove	37	37	30
Harper	...	40	18
Johnson	2	2	24
Lyon	3.5	3.5	22
Morton	10	15	20
Pratt	25	168	24-30
Reno	5	125	28
Riley	3.5	...	...
Sedgwick	44	100.5	30
Shawnee	25	23.5	26
Wichita	20	23	...
Michigan:			
Leelanau	...	40.5	...
Minnesota:			
Aitkin	17	...	24
Brown	...	5	24
Hubbard	...	72.65	...
Otter Tail	...	50	...
Red Lake	1	1.5	24
Sibley	3	...	26
Stearns	9	...	...
Wadena	9	35	24
North Carolina:			
Columbus	50	1,450	18
Mecklenburg	25	270	...
Moore	18	...	...
Nash	15	145	24
Wayne	24	400	24
Ohio:			
Carroll	...	236	...
Darke	...	100	...
South Carolina:			
Darlington	45	1,200	20
Greenwood	6	170	30
Orangeburg	22	508	34
South Dakota:			
Gregory	22	47	...
Tennessee:			
Hardeman	120	...	...
West Virginia:			
Mineral	...	12a	18
Wisconsin:			
Adams	10.8	...	24
Jackson	200	...	...
Monroe	29	...	...
Waushara	5	...	26
Wyoming:			
Natrona	327	936	18

a-oiled.

Bituminous Concrete and Bituminous Macadam

State & County	Miles Built in 1927	Miles in Use, End of 1927	Width of Improved Surface
Alabama:			
Tallapoosa	6 C	...	...
California:			
Marin	7.5C	14	16
Florida:			
Palm Beach	33M	224	18
Pinellas	8.1M	43.8	...
Georgia:			
Cherokee	6M	...	...
Clarke	4M	20	18
Indiana:			
Jefferson	3.6C	...	...
Kansas:			
Allen	10M	30.6	16
Bourbon	6.5M	58	16-18
Kentucky:			
Boyle	5M	6	16
Maryland:			
Baltimore	12M	263	15
Michigan:			
Emmet	0.5M	...	...
Gogebic	3M	12	16
Mason	2.5M	2.5	...
New York:			
Albany	2M	7	14
Cayuga	27M	...	...
Chautauqua	20M	...	...
Herkimer	10.3M	...	10
Jefferson	40M	250	10
Madison	10M	150	10-16
Niagara	3M	163	12-16
Orleans	11.4M	...	...
Oswego	24M	142	12-14
North Carolina:			
Mecklenburg	10.M	36.1	...
Ohio:			
Fayette	5M	...	...
Geauga	8M	...	14-20
Hamilton	30M	...	16
Harrison	3M	80.8	10-18
Jefferson	6M	66	10
Lorain	14M	199.3	10-20
Putnam	3.5M	66.8	18
Wood	35M	377	12-16
Wyandot	25M	...	...
Texas:			
Atascosa	4.7M	18	18
El Paso	9.3C	78	18-24
Hays	27M	...	...
Webb	33.3M	33.3	16
Virginia:			
Augusta	4Ma	160	...
Washington:			
Franklin	3.5M	3.5	...
West Virginia:			
Brooke	3M	...	9-18
Mercer	7M	97	12-20
Wisconsin:			
Dane	62T	...	...
La Crosse	120,113MS 5,473CS	110 5	... ...

C—Bituminous concrete; M—bituminous macadam; a—oiled; T—Tarvia; S—per square yard.

Waterbound Macadam

State & County	Miles Built in 1927	Miles in use, end of 1927	Width of Improved Surface
Florida:			
St. Lucie	30	118	9-16
Idaho:			
Bonner	6a	55	50
Kootenai	.2	...	20
Illinois:			
Monroe	5	...	16
Whiteside	4	...	...
Indiana:			
Jefferson	4	...	...
Kansas:			
Geary	...	1	18
Johnson	0.5	15.5	18
Kentucky:			
Boyle	4	100	16
Campbell	14.7	...	...
Scott	20	450	14
Maryland:			
Caroline	3	20	10
New York:			
Albany	20	144	14
Herkimer	48.3	...	10
Niagara	4	267	12-16
Ohio:			
Geauga	15	...	10-20
Noble	3	35	12
Lorain	3.5	...	10
Putnam	11.6	...	10
Ross	3	...	20
Tuscarawas	6	18.7	16
Oregon:			
Jackson	13	...	16
Klamath	11	65	12
Yamhill	12.3	27	10-14
Washington:			
Skamania	2	...	...
West Virginia:			
Mineral	0.4	10	14
Tyler	2	6	16

a—crushed rock.

Concrete Pavements

State & County	Miles Built in 1927	Miles in County, End of 1927	Width of Improved Surface
California:			
Alameda	2	46	18-24
Marin	5.4	10	16
Florida:			
Pinellas	1R	1	..
St. Lucie	19	19	18
Illinois:			
Iroquois	11.7R	225	10-18
Kane	4R	110	18
Kankakee	10	105	9-18
Lake	21R	190	20
Macopin	12R	12	18
McHenry	4s	88	18-20
Whiteside	6.5R	..	18
Woodford	55	..	18
Indiana:			
Kosciusko	10	77	..
Newton	18	22.5	18
Iowa:			
Harrison	12R	12	18
Scott	2R	86	18
Kansas:			
Allen	3	37.5	18
Brown	0.5R	0.5	30
Cowley	8	15	18
Geary	.1	15R	18-20
Johnson	16.5R	20.5	18
Lyon	4	29	18
Neosho	2.5	2.5	18
Osage	6	7	18
Riley	8	..	..
Sedgwick	44	44	18
Maryland:			
Baltimore	16	77.8	15
Garrett	2	..	..
Kent	0.5	39.1	9-15
St. Marys	6	6	18
Michigan:			
Calhoun	5	..	20
Genesee	17R	61	20
Gogebic	1	1.2	20
Kent	2.2	44	20
Macomb	41R	155.1	20
	6	58.3	20-24
Minnesota:			
Chisago	15R	37	18
Jackson	0.5R	0.5	50
McLeod	2	2	..
St. Louis	3.2R	2.75	18
New Jersey:			
Mercer	0.7R	15.5	..
New York:			
Herkimer	1.1R	..	16
Madison	6	35	10-16
Niagara	15R	101	12-40
Suffolk	20R	145	18-20
Westchester	8.4R	69.6	20-40
North Carolina:			
Columbus	12	53	18
Ohio:			
Darke	2R	46	18
Hamilton	15	..	20
Lorain	2R	41.2	16-20
Miami	0.7sR	..	..
Tuscarawas	8	53.7	16-18
Oklahoma:			
Kay	32.4R	82.2	18
Oregon:			
Douglas	1.7	6.2	16
South Carolina:			
Greenwood	9R	13	18
Tennessee:			
Giles	8s	..	16-18
Loudon	16	16	18
Texas:			
Anderson	10.7	20.7	16-18
Cameron	55R	95	18
Webb	10.8	10.8	18
Wisconsin:			
Calumet	2	15	16-20
Dane	29.6	80	20
Dodge	10.5R	217	18
Dunn	11	..	20
Jackson	4	9	..
Juneau	4R	6	20
Milwaukee	4.3	220	20
Polk	0.5	..	..
Sauk	2R	14	20
Sheboygan	5	45	15-20
Waushara	4.7R	15	20

R—Reinforced: s—by State or State aid.

Other Kinds of Pavement

Kind of Pavement	County	State	Amount Laid
Oiled:	Alameda,	Cal.	21 miles
	Traill	N. D.	1 "
Tar:	Wayne,	Ind.	11 "
Asphalt Block:	Pinellas,	Fla.	38.6 "
Stone:	Newton,	Ind.	7.75 "
Sheet Asphalt:	Baltimore,	Md.	3 "
Amesite:	St. Marys	Md.	6 "
	Brooke,	W. Va.	0.1 "
	Milwaukee,	Wisc.	0.5 "
	Niagara,	N. Y.	0.22 "
Tarvia:	St. Marys,	Md.	Retreated 9 miles; laid 7.5 miles new
Cinders:	Brooke,	W. Va.	3 miles
Brick:	Pinellas,	Fla.	2.1 "
	Geary,	Kans.	3 "
	Hodgeman,	Kans.	0.6 "
	Johnson,	Kans.	8 "
	Lyon,	Kans.	0.5 "
	Miami,	Kans.	5.8 "
	Sedgwick,	Kans.	24 "
	Niagara,	N. Y.	1.75 "
	Lorain,	Ohio	1.3 "
Warrenite-Bitulithic:	Alameda,	Calif.	14 "
	Shoshone,	Idaho	2 "
	Westchester,	N. Y.	2.2 "
	Milwaukee,	Wisc.	4.3 "
Natural Rock Asphalt:	Kosciusko,	Ind.	2.2 "
	Milwaukee,	Wisc.	1 "

Miles of Highways Built by States in 1927

State	Graded only	Sand-Clay on topsoil	Gravel	Water Bound Macadam	Bituminous Macadam	Bituminous Concrete	Concrete	Graded only	Sand Clay on Topsoil	Gravel	Water Bound Macadam	Bituminous Macadam	Bituminous Concrete	Concrete	Other
Arizona	10	...	15.09	...	...	....	5.86	269.03	..	1,221	....	23.43	45.32	146	1.29
California	...	...	184.7	...	11.6	1.8	39.6	...	..	1,745	....	355	109.3	1,671	357c
Colorado	64	2	55.	...	...	2	27.	5,326	98	3,397	....	...	13	262.0	...
Connecticut	0.56	...	5.85	...	13.56	12.43	44.13	115	..	307	764	242.9	147.9	330.6	59.2g
Delaware	...	...	...	43.76	...	...	30.	...	..	....	24	19.3	....	546.0	17.1f
Idaho	10.6	...	3.49e	...	...	...	...	...	..	....	...	....	....	...	...
Illinois	...	12.	164.7	124.4	15.6	14.2	1.2	497	83	1,034	840	15.6	136.8	51.9	83.4
Iowa	174.	...	7.6	5.	...	...	...	174	..	175	60	17.3	...	...	...
Kansas	735	...	457	...	...	...	631	1,417	..	3,225	....	....	9.4	6,060	161.6hs
Maine	300.	127.	44.	...	31.	...	320.5	944	516	283	....	125	....	939.7	...
Massachusetts	...	...	408.77	...	12.52	...	38.	...	4	4,082	...	295	....	485	128h
Michigan	1	...	59.	4	144.	31	19.	12,500	..	5,400	20	295	....	117.5	6.49l
Minnesota	...	...	75.41	3.15	...	24.62	25	86	88	3,290	2,100	2,600	900	400	380j
Mississippi	349.1	...	238.7	...	...	...	248.59	...	..	3,466	366	129	272	1,883	831k
Missouri	87.3	...	122.3	...	...	...	113.9a	...	..	3,235	....	....	....	934.5a	3941
Nevada	359	...	366	...	...	...	81.1	686	..	2,204	....	94	....	276.8	10h
New Hampshire	...	...	113.49	...	...	...	216	1,431	..	1,226	....	12	....	1,451	163r
New Jersey	1	...	113	...	...	...	3.92	19	10	915	....	153	56	50	4.81
New Mexico	7.12	...	3.45	7.25	20	2	10	34	..	7	94	67	67	25	...
North Carolina	324	...	176	...	0.86	...	131.65	7	..	83	....	55	242	484	32.8
North Dakota	277.5	221.99b	...	27.84	8.80	31.32c	395.51	524	1,831	1,720	....	....	0.7	72.4	...
Ohio	586.	...	409.	...	...	...	...	646	120	120	....	285	1,136c	3.1	...
Oklahoma	50.	...	600.	32.	55.	...	...	1,599	..	1,723	....	....	....	1,855	820m
Rhode Island	81	...	27.4	0.5	...	2.5	135.	603	..	3,470	....	....	8.4	...	9.7
South Carolina	...	...	....	2.0	20.6	3.5	25.9	533	..	1,512	1,289	2,047	64	1,724	400.2n
South Dakota	...	295b	...	...	...	...	15.9	...	..	23	118	135	210	694	36.3h
Texas	388.	19.	464.	...	...	20.4	175.4	...	1,903b	....	....	....	120	76.7	8.4p
Washington	389.45	25.02	...	76.48b	...	364.25d	107.51	4,800	30	2,896	....	....	139.4	382.4	78.7s
West Virginia	45.	...	80.	...	...	...	62.	1,621	467	....	3,791b	....	....	3.1	...
Wyoming	339.54	...	314.88	...	82.14	...	67.74	145	..	2,000	....	31	1,726d	536.5	47.4f
	93.24	...	113.89	...	...	...	1.14	829	..	646	....	94	42	588	14h
								624	..	994	....	....	87.3	540.6	212q
									..	....	....	....	27.1	12.2	...

a—Includes bituminous concrete, concrete and brick; b—Includes gravel; c—asphaltic concrete; d—includes bituminous macadam; e—surface treated; f—brick 6.14 and sand asphalt 10.98; g—1.63 miles brick; h—brick; l—granite block; j—30 miles of brick; k—10.6 miles brick; l—treated gravel; m—44.45 of this are brick, rest is oiled; n—14.2 are of brick; p—sheet asphalt; q—145.9 miles of brick; r—21 miles are of brick; s—sheet asphalt.

Miles of Highways in Use by States End of 1927

State	Graded only	Sand-Clay on topsoil	Gravel	Water Bound Macadam	Bituminous Macadam	Bituminous Concrete	Concrete	Graded only	Sand Clay on Topsoil	Gravel	Water Bound Macadam	Bituminous Macadam	Bituminous Concrete	Concrete	Other
Arizona	10	...	15.09	...	...	....	5.86	269.03	..	1,221	....	23.43	45.32	146	1.29
California	...	...	184.7	...	11.6	1.8	39.6	...	..	1,745	....	355	109.3	1,671	357c
Colorado	64	2	55.	...	...	2	27.	5,326	98	3,397	....	...	13	262.0	...
Connecticut	0.56	...	5.85	...	13.56	12.43	44.13	115	..	307	764	242.9	147.9	330.6	59.2g
Delaware	...	...	...	43.76	...	...	30.	...	..	....	24	19.3	....	546.0	17.1f
Idaho	10.6	...	3.49e	...	...	...	...	...	..	....	...	....	....	...	...
Illinois	...	12.	164.7	124.4	15.6	14.2	1.2	497	83	1,034	840	15.6	136.8	51.9	83.4
Iowa	174.	...	7.6	5.	...	...	...	174	..	175	60	17.3	...	...	...
Kansas	735	...	457	...	...	...	631	1,417	..	3,225	....	....	9.4	6,060	161.6hs
Maine	300.	127.	44.	...	31.	...	320.5	944	516	283	....	125	....	939.7	...
Massachusetts	...	...	408.77	...	12.52	...	38.	...	4	4,082	...	295	....	485	128h
Michigan	1	...	59.	4	144.	31	19.	12,500	..	5,400	20	295	....	117.5	6.49l
Minnesota	...	...	75.41	3.15	...	24.62	25	86	88	3,290	2,100	2,600	900	400	380j
Mississippi	349.1	...	238.7	...	...	...	248.59	...	..	3,466	366	129	272	1,883	831k
Missouri	87.3	...	122.3	...	...	...	113.9a	...	..	3,235	....	....	....	934.5a	3941
Nevada	359	...	366	...	...	...	81.1	686	..	2,204	....	94	....	276.8	10h
New Hampshire	...	...	113.49	...	...	...	216	1,431	..	1,226	....	12	....	1,451	163r
New Jersey	1	...	113	...	...	...	3.92	19	10	915	....	153	56	50	4.81
New Mexico	7.12	...	3.45	7.25	20	2	10	34	..	7	94	67	67	25	...
North Carolina	324	...	176	...	0.86	...	131.65	7	..	83	....	55	242	484	32.8
North Dakota	277.5	221.99b	...	27.84	8.80	31.32c	395.51	524	1,831	1,720	....	....	0.7	72.4	...
Ohio	586.	...	409.	...	...	...	...	646	120	120	....	285	1,136c	3.1	...
Oklahoma	50.	...	600.	32.	55.	...	...	1,599	..	1,723	....	....	....	1,855	820m
Rhode Island	81	...	27.4	0.5	...	2.5	135.	603	..	3,470	....	....	8.4	...	9.7
South Carolina	...	...	....	2.0	20.6	3.5	25.9	533	..	1,512	1,289	2,047	64	1,724	400.2n
South Dakota	...	295b	...	...	...	...	15.9	...	..	23	118	135	210	694	36.3h
Texas	388.	19.	464.	...	...	20.4	175.4	...	1,903b	....	....	....	120	76.7	8.4p
Washington	389.45	25.02	...	76.48b	...	364.25d	107.51	4,800	30	2,896	....	....	139.4	382.4	78.7s
West Virginia	45.	...	80.	...	...	...	62.	1,621	467	....	3,791b	....	....	3.1	...
Wyoming	339.54	...	314.88	...	82.14	...	67.74	145	..	2,000	....	31	1,726d	536.5	47.4f
	93.24	...	113.89	...	...	...	1.14	829	..	646	....	94	42	588	14h
								624	..	994	....	....	87.3	540.6	212q
									..	....	....	....	27.1	12.2	...

a—Includes bituminous concrete, concrete and brick; b—Includes gravel; c—asphaltic concrete; d—includes bituminous macadam; e—surface treated; f—brick 6.14 and sand asphalt 10.98; g—1.63 miles brick; h—brick; l—granite block; j—30 miles of brick; k—10.6 miles brick; l—treated gravel; m—44.45 of this are brick, rest is oiled; n—14.2 are of brick; p—sheet asphalt; q—145.9 miles of brick; r—21 miles are of brick; s—sheet asphalt.

FINANCIAL STATISTICS OF STATE ROAD WORK

State	Total Spent in 1927	Spent in maintenance	To be Spent in 1928
Arizona	$1,890,813a	$777,484	$5,000,000
Arkansas	.....	.....	18,000,000
California	15,712,311	5,217,586	20,000,000
Colorado	5,503,000	863,720	5,503,000
Connecticut	12,778,981	3,741,071	15,000,000
Delaware	2,405,736	161,962	2,225,000
Florida	21,000,000	.....	17,000,000
Idaho	3,367,500	872,000	3,711,000
Illinois	24,600,000	2,700,000	56,000,000
Iowa	16,341,641	3,743,210	35,000,000
Kansas	6,312,296b	none	8,200,000
Kentucky	10,000,000	.....	10,000,000
Maine	8,782,017c	1,798,386	8,900,000
Massachusetts	15,204,629	8,198,534d	14,000,000
Michigan	18,000,000	4,750,000	22,000,000
Minnesota	19,300,000	4,500,000	19,800,000
Mississippi	5,000,000	1,600,000	5,000,000
Missouri	13,503,207b	3,234,441	9,000,000
Montana	.....	.....	2,250,000
Nevada	2,199,430	331,735	1,701,038
New Hampshire	3,289,555	1,850,000	4,580,000
New Jersey	24,959,450	1,759,825	24,959,450
New Mexico	5,088,904	1,002,722	5,100,000
New York	48,000,000	.....	50,000,000
North Carolina	24,283,100	3,429,538	25,300,000
North Dakota	5,044,736	855,197	5,043,146
Ohio	24,469,353	13,552,434	32,000,000
Oklahoma	12,816,236	2,192,797	.....
Rhode Island	3,430,000	762,000	3,500,000
South Carolina	12,443,457	2,211,820	15,000,000
South Dakota	4,011,118	1,164,840	4,000,000
Texas	13,981,719	8,469,625	16,000,000
Washington	8,628,000	2,249,670	12,000,000
West Virginia	13,988,885	2,117,247	5,500,000
Wyoming	2,873,444	721,067	2,870,000

A—does not include overhead; b—construction on State system only; c—not including interest and maturity on bonds; d—includes reconstruction.

The Use of Dust Layers

Out of three hundred representative counties which were questioned regarding their use of dust layers, 189 reported they did not use them; 43 reported using dust layers more or less regularly; and 68 did not answer. Of the 43, 19 reported using tars, asphalt and oils, and 24 used calcium chloride. Michigan appears to be the leading State in employing such dust layers, calcium chloride being used by most of the counties. One county stated that they let rain and snow settle the dust.

Width of Bridges and Culverts

Reports from several hundred counties show that, as a rule, culverts are now being made wider than ever. In most counties they are the width of the roadway and shoulders of the road. One county in New Jersey reports a culvert width of 66 feet, and a number reported widths in excess of 30 feet. Out of 253 counties giving specific information, 26 reported that culverts were built 30 feet wide, 18 reported a width of 28 feet, 19 a width of 26 feet, 25 a width of 25 feet, 61 a width of 24 feet, 9 a width of 22 feet, 41 a width of 20 feet, 26 a width of 16 feet, 2 a width of 14 feet, and 4 a width of 12 feet; 23 others gave varying widths up to 50 feet. One county reported culverts the full width of the roadway, and another as being made 5 feet wider than the fill.

Roadway widths on bridges are normally considerably narrower. Of the 69 counties reporting on bridges for 1928, 16 planned to make their bridges 16 feet wide, 24 to make them 18 feet wide, 20 to make them 20 feet wide, 8 to make them 24 feet wide, and one 26 feet.

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County Roads

About three-quarters of a billion dollars will be expended on road construction and maintenance during the coming year by the counties of the United States. As will be seen by reference to other pages of this issue, where will be found summarization of road work done during the past year by a number of counties, most of these roads will be of the so-called "low-cost" type. The use of such types is necessary to meet the widespread demand for large mileage of readily travelable roads, without the expenditure of excessive amounts of money.

Given unlimited appropriations, almost anyone can build a fine road system; but the construction of smooth and durable roads, at costs within the reach of the average county, requires a high degree of engineering skill and training. An analysis of many hundred returns received during the past month from county engineers and highway superintendents over the entire country gives undoubtable evidence that the great majority of these men are well fitted for their work and that many of them are possessed of unusual ability in organization and administration. That so many of our counties have had the good judgment to employ engineers of the requisite capacity for the work is gratifying. It would be still more pleasing to know that the pay and support granted these men are commensurate with their ability.

Awards to "Responsible Bidders"

The engineer has the right to specify the qualities of the material going into the job; he should also have the right to require certain standards on the part of the man using these materials. The objective of any contract is the prompt and skillful combination of materials in compliance with specifications to form the desired structure. This objective cannot be attained unless the constructor is responsible financially and technically.

The State Supreme Court of Florida has recently upheld the State Highway Department in this important point. The legislature, the opinion of the Supreme Court says, vested in the road department the "power, authority and duty" to determine bidders adjudged responsible by the department, not only from a standpoint of dollars and cents, but from information available to and acquired by the department.

In determining the "responsible bidder," the court held, the department should ascertain the degree of experience, reputation of performance, possession of facilities, obligations and other matters, which might have an influence upon the ability of the contractor to perform the contract.

"The statute unquestionably vested in the state road department the discretion to determine who are and who are not responsible bidders," the court held.

Report on St. Francis Dam Failure

Last month we gave the conclusions relative to the cause of the failure of the St. Francis dam which had been reached March 24th by the board of inquiry appointed by Governor Young. The entire report, not then available, confirms unofficial state-

ments referred to by us as to the failure of the foundation. The board consisted of three consulting engineers—A. J. Wiley of Boise, Ida., H. T. Corey of Los Angeles, and F. H. Fowler of San Francisco; two professors of geology, Geo. D. Louderback and F. L. Ransome; and F. E. Bonner, district engineer U. S. Forest Service and California representative of the Federal Power Commission. The findings of this board are confirmed by those of three other investigating bodies and the coroner's jury.

The report states that the dam itself was practically watertight, but seepage took place through the foundation, increasing, as the water rose, to between one and two second feet on the afternoon preceding the failure. An automatic register located in the standing portion of the dam showed that the water level behind the dam fell about 1.1 foot between 11.30 and 11.58 P. M., when the dam broke. The indications are that during this 28 minutes the water was escaping under the western part of the dam and washing out a considerable hole in the foundation rock.

How this could occur is the interesting feature of the investigation. The central and eastern part of the valley is a fairly durable mica schist; but the western side is a reddish conglomerate which, when dry, acted like solid rock but "when a piece of the rock is placed in water a startling change takes place. Absorption proceeds rapidly, air bubbles are given off, flakes and particles begin to fall from the sides of the immersed piece, the water becomes turbid with suspended clay and, usually in from 15 minutes to an hour, a piece the size of an orange has disintegrated into a deposit of loose sand and small fragments, covered by muddy water." These two kinds of rock are separated by a fault in which is found several inches in width of material which, "when wet is an unctuous, plastic clay."

"With such a formation, the ultimate failure of this dam was inevitable, unless water could have been kept from reaching the foundation."

While the failure of the dam is thus apparently explained, we have not learned of any satisfactory explanation of how the engineers failed to learn of the nature of the foundation; or, knowing it, felt justified in placing the dam upon it.

The lesson to be learned is obvious: that without a durable and otherwise sufficient foundation, no masonry dam is safe; and every nature of test of the rock, its porosity and other characteristics when subjected to water under pressure, its depth, and the geological formation at the site should be thoroughly made by competent experts before deciding upon a site.

New Zoning Legislation

New zoning legislation was enacted last year in 23 states, according to the Department of Commerce. A canvass of the situation made by the Division of Building and Housing of the Department, of which Dr. John Gries is chief, showed that the standard state zoning enabling act, which was prepared five years ago by a committee appointed by the Secretary of Commerce, has been used wholly or in large part in the laws enacted in 29 states.

The zoning legislation adopted last year ranges all the way from complete state acts applying to all clases of municipalities, to acts that apply to a single city. By the end of the year, zoning laws had been enacted by 45 states and the Dist. of Columbia, while in another state it had been held that zoning is permissable under existing home rule provisions of the state constitution. The division learned of the names of 63 cities, towns, and villages which had adopted zoning ordinances during 1927, which increases the number of zoned municipalities in the United States to 583, which had a population of more than 31,000,000 inhabitants by the 1920 census, which population is probably now well in excess of 35,000,000. These include 55 of the 68 cities which in 1920 had more than 100,000 population, and zoning activities in the remaining 13 cities of that group are in various stages of development. At the other end of the list with respect to size are 53 municipalities of less than 1,000 population. In the 583 zoned cities dwell more than 57% of the urban population of the United States.

Speeding Cause of Most Motor Accidents

A summary of all automobile accidents reported to the New Mexico Highway Department for the six months period between July 1, 1927, and January 1, 1928, shows speeding to be the most prolific cause of motor car smash-ups.

Out of a total of 109 accidents recorded, 31 or 29% were due to speeding. Incompetence or carelessness was responsible for 22 accidents; 13 were caused by intoxicated drivers and faulty vehicles resulted in 10 accidents. In only 11 cases, none of which was serious, was the condition of the road or poor highway design directly the cause of accident, the other ninety-eight being attributed to causes beyond the control of the Highway Department.

Of the 11 accidents for which responsibility might be attached to the department, 4 were collisions at narrow bridges or fills, 2 at narrow cattle guards, 4 were caused by blind curves and 1 by loose sand on the roadway.

All these unsatisfactory conditions are being remedied as rapidly as possible. Narrow bridges on state roads are being replaced with two-lane traffic bridges and approach fills widened as rapidly as funds will permit. All narrow cattle guards on state roads have been condemned and good progress is being made with the substitution of 24-foot cattle guards. Two Highway Department power shovels are constantly at work widening narrow roads, eliminating blind curves and reducing grades. With the adoption of tandem maintenance, the ridge or loose material left in the center of the roadway by the single maintaining unit has been done away with and accidents so caused should become nil in 1928.

Of the total 109 accidents reported, 40 occurred on straight roads, 30 on curves, 8 on hillsides, 4 at bridges or approaches, 2 at spillways, 2 at cattle guards and the remainder at various unclassified locations.

The condition of the highway was reported as

"good" or "fair" in 76 cases of accident. Slippery roads due to rain or snow caused 10 accidents.

Seventeen automobiles were totally wrecked, 60 badly damaged and 29 slightly damaged. Twelve persons were killed and eighty injured in these 109 motor vehicle accidents. Six deaths were the result of speeding, one was caused by carelessness, one by incompetent driving, one by intoxication, one by reason of failure of brakes on steep hill and two at a railroad grade crossing. In the last instance mentioned, the view of the tracks was unobstructed for several hundred feet either way from the crossing.

The Highway Department is requiring the reporting of automobile accidents for the express purpose of seeking the cause, and, if possible, removing it. To this end the cooperation of the motoring public is earnestly solicited in obtaining all the facts in connection with every accident.

Maintenance of Gravel Roads in Nova Scotia

Their maintenance is the chief problem of the Province. Organization, methods and equipment of the Department of Highways.

By R. W. McClough*

In the Province of Nova Scotia all roads, except those through cities and towns and a certain few private roads, are the responsibility of the Department of Highways. This gives the Province 15,000 miles of highway, or .03 mile per capita.

Of this mileage, 5,000 miles have been surfaced with gravel and comprise our more important roads. We consider that economic, climatic and traffic conditions indicate that for many years to come the gravel-surfaced road is the one best suited to the needs of the province. There will be short pieces of road over which the traffic is unusually dense where higher types of construction will prove to be more economical and will be constructed. The immediate problem of the province, however, is to maintain our system of gravel roads at a high standard, and at a minimum of cost. It is to be noted in this regard that it is found invariably that the motoring public insists on perfect roads wherever highways have been reconstructed.

Roadway Must Be Properly Constructed: Satisfactory maintenance depends upon a proper construction. The elements of proper construction:

(1) Good drainage.
(2) A top so nearly flat that it cannot be called convex or concave.
(3) A minimum width of twenty-four feet.

Maintenance Organization: Deterioration of a gravel road can only be averted by vigilant maintenance. The riding qualities of a gravel road more than that of any other type are affected by the class of maintenance to which it is subject. Systematic maintenance is essential if traffic riding conditions are to be maintained.

Systematic maintenance means a patrol system. The length of the patrol depends upon a number of factors: density of traffic, quality of gravel, etc., and will vary from three to six miles. Proper equipment is the first essential of a satisfactory patrol. Maintenance work should be performed by machinery whenever possible, and if necessary the foreman should have a helper. The patrolman should not undertake heavy repairs, but these should be left to a foreman and special gang, enabling the foreman to attend to his regular duties.

Spring Maintenance: In the spring of the year the surface of a gravel road, due to the frost and traffic, is usually somewhat rutted and does not conform to the cross-section to which it was constructed. If the spring maintenance is undertaken immediately after the snow leaves the travelled way, for two weeks the surface of the roadway is found to be plastic and can be reshaped without difficulty. A dollar spent at this time will accomplish more than three dollars can perform a month later. It is of first importance to note also that only at this time can the material found in the road be properly "graded": the heavier gravel placed at the base and the finer on the surface of the road.

In Nova Scotia our first step in the maintenance of our gravel road is to completely rip up the surfacing down to the sub-grade. For this purpose we use our heavy construction machinery which consists of ten-ton tractors and twelve-foot blade graders. The road is brought back to its proper cross-section, and is handed over to the patrolman in perfect condition. By this method, the surface of the road is remade every year. The fine material is brought back to the surface and uneveness eliminated.

Supply of Maintenance Material: The two most important factors in the maintenance of gravel roads are:

(1) The addition of maintenance material, and
(2) Intelligent grading.

The gravel necessary for maintenance should be stock-piled along the right-of-way, and it will be found advantageous to have a year's supply ahead. This is necessary for the reason that additional gravel can best be applied in the spring and late

A NOVA SCOTIA ROAD UNDER MAINTENANCE

*Chief engineer, Department of Highways, Province of Nova Scotia.

fall, at which seasons hauling conditions are generally inferior.

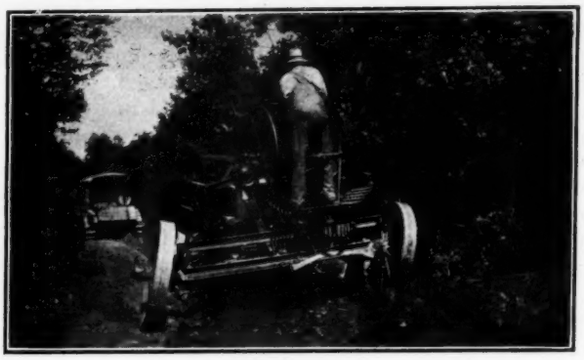
The kind of gravel used is an economic problem; the factors being durability and cost. It is understood, of course, that the material used must give satisfactory riding qualities. Extremely hard gravel does not make the best maintenance material. The ideal gravel for maintenance is one which is soft enough to break up sufficiently to supply fine material, but which is clean and will not produce mud, and has sufficient hard material to leave a light coat of free gravel on the surface.

No set rule can be laid down for the size of gravel. For extremely hard material one hundred percent should pass a one-half-inch screen, while for fairly soft material one hundred percent should pass a one-inch screen. In many localities it is necessary to employ crushing and screening plants to produce satisfactory material.

The amount of material which must be added yearly depends largely on the traffic carried, and also on the quality of the surfacing. With a well constructed roadbed carrying six hundred to seven hundred vehicles per day, it will be found that, on an average, 200 cu. yds. per mile must be replaced each year. There should always be a small reserve of gravel on the shoulders of the roadway, and sufficient width for that purpose must be provided at time of construction.

The proper maintenance of a gravel surfaced road calls for scientific methods; the rule of thumb methods of Farmer Jones no longer apply. The old method of dragging the road from sides to the centre must give way to the method of grading from one side to the other. When this is done the dragging will commence from the right side of the road and go to the left one day, and on the following day the operation is reversed. A large quantity of free gravel inconveniences the motorist. Such a coat of gravel is absolutely unnecessary, as only enough gravel need be placed on the road to provide material with which to "sweep" the road.

Regardless of weather conditions, the roadway should be dragged as often as may be necessary to maintain a coat of free gravel and prevent ripples. This frequency depends not only on the volume of traffic but also on the characteristics of the surfacing material. However, on an average, it is necessary to drag it after every six hundred vehicles have passed.



TRACTOR HAULING BLADE GRADER IN NARROW ROAD

If road maintainers are operated at a speed in excess of three miles per hour, they will jump about and chatter, and as a result will leap over the humps instead of cutting them off. It is, therefore, essential that maintainers be operated at a rate of speed not exceeding three miles per hour.

Hauling Surfacing Material: The material for surfacing can best be supplied by a floating gang with a fleet of light trucks, together with loading and screening equipment and, if necessary, a crusher.

MAINTENANCE EQUIPMENT

Crushing Plants: It is not possible economically to produce fine maintenance material with the ordinary jaw or gyratory crusher. Special reduction crushers of both the jaw and gyratory type are now manufactured which will produce fine material at a reasonable cost. Where it is necessary to move the plant several times per year, the outfit should be portable. However, the efficiency of the plant should not be sacrificed to produce portability. Complete gravel crushing and screening plants are now being manufactured.

Grading or Dragging Equipment: Considerable progress has been made in the past ten years in the development of road working machinery. These improvements have extended to machinery for dragging or grading gravel roads, and it is generally admitted that such machinery has effected great economies. The first machine in the market was the split-log drag. Then came the light steel drag. When the maintenance of gravel roads became a full-time job, the light horse patrol grader weighing about 700 pounds made its appearance, but was found to be too light and was generally superseded by a horse patrol grader weighing about 1300 pounds.

Where heavy traffic exists we have found it practically impossible to maintain gravel roads satisfactorily with horse patrol graders, but use heavier motorized drags and blade graders. Of these machines there are at least three types, as follows:

TRACTOR HAULING GRADER ON ROAD WIDENING WORK

(1) The blade grader with power plant attached and either wheel or caterpillar traction.

(2) The blade grader pulled by a separate power unit.

(3) The various types of heavy multi-blade drags pulled by separate power unit.

While these machines effect economies and produce fairly satisfactory work, there is still room for considerable improvement in design. I feel quite confident that within the next few years we shall have at our disposal a machine very much more effective than any now on the market.

Improvements in machinery follow behind improvements in road construction. At the present time, practically all the single-blade maintainers which have been put on the market have been adaptations of the road machine. The work which they have to do is distinctly different, and they have, therefore, not been entirely satisfactory. If the blade grader is going to survive, it will have to be designed so as better to fulfil the requirements of the work it has to do. For example, if the blade of this grader is once raised in going over a bump owing to its design it is apt to repeat this inequality indefinitely. Result is a bumpy road. The multi-blade drag has not this drawback, and for this reason, as well as others, may possibly win out as the universal maintainer. However, it has the disadvantage of being less easily controlled by the operator.

Quality of Machinery: In the past, much road machinery has been manufactured to a price rather than to a standard. This is the fault of the buyer more than the manufacturer. The manufacturer must sell in order to exist. He can, therefore, manufacture only what we will buy.

In purchasing maintenance machinery, we must first determine the type of machine we wish to buy, and secondly the particular make. The lowest priced machine is not always the cheapest. What is needed is a machine that will do the work for which it is intended and do it continuously over a reasonable number of years. We should assure ourselves that the machine we are purchasing is not over-priced, but we should also be satisfied that it is the best machine of its type on the market. In road making, expensive machinery often spells economy.

Road maintainers have a tough job, and their design, material and workmanship should be the best possible. It is also essential that repair parts and service be available at a reasonable cost.

Cost of Operation: If a horse patrol, double team and driver, cost say $6 per day to operate, the motor grader in those circumstances, will not do the work any cheaper. It will, however, maintain a much better surface. With a traffic of five hundred cars per day a motor grader will maintain satisfactorily twenty-four miles of highway.

DUST LAYERS

The most serious disadvantage of gravel roads is the dust nuisance. This can be abated by the use of either calcium chloride or light oils. Before either of these substances is applied, however, it is essential that the road surface be covered with ¾" of fine clean gravel or crushed stone.

Calcium chloride should be applied moderately. If too much is applied at one time, it will form a crust which will necessitate scarifying in order to restore the riding qualities of the road. Only sufficient quantity should be applied to keep down the dust, and the roadway should be given as many applications as are necessary. One pound per square yard will be found about right for the first application, and ½ pound for further applications.

Light asphaltic oils of about thirty-five to forty-five percent asphaltic base have been used to a limited extent in Nova Scotia, and have given satisfactory results as a dust layer. This oil should be applied in two applications with an interval of a month between. For the first application we use about 1/5 gallon per square yard, and for the second application ⅛ gallon per square yard.

Our main objection to the use of light oils is our lack of storage and distributing equipment. For this reason we use mostly calcium chloride, which requires practically no expensive equipment.

The dust abatement cannot be considered apart from road preservation. Blowing away of fine material on the surface of the road is one of the principal factors in deterioriation, so it follows that if the dust is prevented a substantial contribution is being made to maintenance. Apart from the dust nuisance, the point in the traffic density curve where the use of a dust preventive is indicated as an economic factor in road maintenance must be determined by experimentation for different classes of road material. With an increasing traffic on certain highways, the use of a dust preventive will delay the necessity of constructing a hard-surface road.

Report on Activated Sludge Plants

After inspecting ten such plants, committee recommends that New York City adopt activated sludge for disposal plant on Ward's Island

On February 16th last the Board of Estimate and Apportionment of New York City directed the comptroller, C. W. Berry, and chief engineer, Arthur S. Tuttle, to inspect methods of sewage disposal in use in other cities. They have recently completed an inspection of ten activated sludge plants and several others, being aided by the sanitary engineer of the board, Kenneth Allen, and by George W. Fuller at four of the plants.

The committee's report, dated March 30th, is given below. A later report, now being prepared by Mr. Allen, will review in detail the salient features of all of the plants examined.

Pursuant to instructions, the committee has inspected ten activated sludge plants at Milwaukee, Indianapolis, Chicago, (DesPlaines river plant), Lodi, Pomona, Pasadena, Harbor City, Grand Canyon and Houston (two plants). The committee has also visited the experimental plant at Calumet and the North Side plant now under construction in Chicago.

In connection with the inspection, advantage was taken of the opportunity to examine the Imhoff tank plant at Calumet and the one now under construction

for the west side of Chicago, the Antigo sludge digestion plant, where gas is produced and utilized, the screening plant at Long Beach, where screenings are incinerated, and the largest screening plant in the world, located in Los Angeles.

Of the activated sludge plants in operation, those at Milwaukee, Indianapolis and Houston are by far the largest, the two former having a capacity of 86 million and 50 million gallons per day, respectively, while that of the combined plants at Houston is about 13 million gallons daily.

The Pasadena plant has a capacity of about 9 million gallons daily, but the present volume of sewage is only about 6 million gallons daily.

The remaining activated sludge plants now in use range in capacity from 4.5 million gallons daily at DesPlaines river to about 80,000 gallons per day at the Grand Canyon.

The new North Side plant in Chicago is to have a capacity of 175 million gallons daily.

In all of the existing plants experimental work is still in progress, and, as a result of these studies, changes are being made from time to time to secure increased efficiency or in the interest of economy.

In some of the plants operating troubles have developed by reason of the admission of trade waste, but in all such cases remedial measures have been or are now being devised and applied.

The plants visited gave ample evidence that the activated sludge process can be relied upon to remove upwards of 90 per cent. of the suspended matter and 95 per cent. of the bacteria. At the Grand Canyon, where water has to be brought a long distance in tank cars and costs $3 per thousand gallons, the effluent, after chlorination, is used for supplying locomotives, power plants, toilets and lawn sprinklers. Where the effluent passes into streams used for irrigation, as at Lodi, Pasedena and Pomona, chlorination is also resorted to as a safeguard.

At Milwukee, Chicago (DesPlaines river) and Pasadena the sludge is converted into fertilizer, the first named plant developing about 100 tons per day; this is sold at a price which appears to be about sufficient to cover operating expenses.

At the larger of the two Houston plants the manufacture of fertilizer has been carried on, but the equipment was considered unsatisfactory and is now being replaced; pending the completion of the new construction, the sludge at that plant, as well as at the smaller plant, is being lagooned. Lagooning is also resorted to at Indianapolis, and sludge drying beds are used at Pomona, Lodi and Harbor City, the dried sludge being used by farmers for fertilizer. At Ponoma the effluent is to be used for irrigation and its sale for that purpose has been negotiated.

The sludge from the new North Side plant in Chicago is to be pumped to the West Side plant, and, after digestion at that point in Imhoff tanks, it will be used for fill.

The inspection was made to include a number of plants in the far south in order to determine whether a nuisance existed in hot weather, but the season was somewhat too early for this purpose and the temperature rarely, if ever, exceeded 70 degrees at the time of the visit.

From our observations it would appear that no odors or objectionable conditions developed up to the point of the disposal of the sludge. The lagooning process is attended with the development of odors which vary in offensiveness with the condition of the lagoon, while the sludge drying beds seem to be inoffensive. The plants used for the manufacture of fertilizer are probably responsible for a marshy or coffee odor, which is not seriously offensive, and which apparently is or can be kept under such control that the plant cannot be charged with conditions any more objectionable than usually occur in manufacturing plants. In some of the plants of the latter character some trouble has been experienced by reason of the development of fire in the dryer but this is believed to be wholly a matter of proper operation.

The committee is of the opinion that the conditions which exist in the East river and in the Harlem river in the vicinity of Ward's Island demand the utilization of the most efficient treatment process that is available, and that the activated sludge process meets this requirement, the sludge being disposed of either at seat or by conversion into fertilizer.

In the absence of a comprehensive survey of the tributary area, it is believed that there are no trades contributing waste which would interfere with the successful operation of such a plant, but that it would be necessary to enforce the ordinance relative to the exclusion of oil and gasoline from the sewers and perhaps to make the same more drastic.

The Board has already recognized the necessity for introducing a process at least equal in efficiency to the activated sludge process at some future time at Jamaica and Sheepshead Bay, where areas have been acquired for this purpose. It is also quite evident that the conditions which exist at the Hendrix street plant in the Borough of Brooklyn will require similar treatment.

We are of the opinion that the plant proposed at Ward's Island should be designed with a view to converting the sludge into fertilizer, either at once or after further studies have been made, and that the fertilizer plant should be given a location in an unrestricted area where it can conveniently serve as many of the additional sludge producing plants as may be found practicable and where shipping facilities can be provided.

It is evident to the committee that the construction and operation of activated sludge plants demands a high order of civil, mechanical and electrical engineering ability, as well as the assistance of skilled chemists and biologists, and that the services of men experienced along these lines, and particularly in their relation to this process, must be secured if the difficulties which have been encountered elsewhere are to be avoided.

Treating Laundry Wastes

A laundry in Maryland, which, operating three days a week, discharged the usual laundry waste at a rate of approximately 850 gallons per hour, was sued by lower riparian owners for pollution of the stream. After unsuccessful efforts to treat the waste by means of a filter, a waste treatment plant was installed which consisted of a wooden mixing and subsidence tank into which the laundry wastes were discharged after being treated with iron and lime

at the rate of 35 and 105 grains per gallon, respectively.

A brief description of this treatment is given by Abel Wolman, chief engineer of the Maryland State Department of Health, in his report for 1927. At that time the chemicals were being shovelled into the channel which carried the laundry wastes before they entered the subsidence tank, but it was expected that a better method would be provided for feeding the chemicals and mechanical means for mixing them with the wastes.

It was at first proposed to discharge the effluent from the subsidence tank directly into the stream, but because the effluent continued objectionable a large cinder and gravel oxidizing bed was installed, the effluent from which is discharged into the stream. This secondary treatment provides excellent clarification, and with the meager data now available, shows a doubling in the oxygen content of the cinder bed effluent as compared with the tank effluent. Because of the heavy solids load on the cinder oxidizing bed, the officials of the company proposed installing an additional tank between this bed and the subsidence tank. The present subsidence tank will then be used for a mixing tank only and the wastes will be discharged into the new subsidence basin and then on to the cinder bed.

International Congress of Cities

Announcement was made several months ago that the Fourth International Congress of Cities would be held at Seville, Spain, this fall, beginning October 5th. As an additional attraction, it was proposed to have an advance opening at that time of the Ibero-American Exposition. The International Union of Cities has just announced that the Spanish Government finds it impossible to open the exposition before next spring and asks that the congress be postponed until then. No date has been set, but the congress probably will not meet before the latter part of April.

Itemized Paving and Sewer Bids

Following are the itemized bids for the construction of Sect. 4 of the Supplementary Joint Trunk Sewer to serve a group of New Jersey municipalities including East Orange, Hillside, Irvington, Maplewood, Millburn, Newark, Roselle Park, South Orange, Summit, Union and West Orange. Alexander Potter, New York, is consulting engineer.

Item	Amount Cu. Yds.	Low Bid	Average next 3 bidders
Earth excavation	27,700	$1.00	$1.37
Concrete, Class "B"	50	20.00	21.00
Concrete, Class "C"	300	15.00	15.00
Concrete, Class "D"	300	12.00	13.00
	Lin. ft.		
42-inch precast sewer (0-8' deep)	2,600	5.93	6.43
36-inch precast sewer (0-8')	840	4.80	5.00
33-inch precast sewer (0-8')	5,510	4.45	4.75
33-inch precast sewer (8-12')	2,270	4.45	4.91
33-inch precast sewer (12-16')	140	4.45	5.42
33-inch precast sewer (16-20)	70	4.45	5.92
33-inch precast sewer (20-24)	120	4.45	6.50
33-inch precast sewer (24-28)	100	4.45	7.50
30-inch precast sewer (0-8)	570	3.73	3.67
30-inch precast sewer (8-13)	4,410	3.73	3.82

Unit Prices on New Mexico Highway Work

Following are unit prices on bids received February 1, 1928, for Federal Aid highway improvements by the New Mexico Highway Department.

No. and Location	Amount Cu. Yds.	Successful bid	Average Next 2 bidders
Common Excavation			
28 REO	1,586	$.40	.....
122 A	51,950	.27½	$.35
125 C	16,056	.25	.18½
125 D	15,795	.20	.21½
Borrow			
28 REO	3,715	.30	.....
122 A	92,814	.27½	.31
125 C	305,810	.19	.19
125 D	126,479	.20	.21½
Overhaul	Sta. yds.		
28 REO	1,472	.03	.....
122 A	15,107	.03	.03
125 D	16,562	.03	.03
Cement Concrete Pavement	Sq. Yds.		
28 REO	7,981	2.25	.....
122 A	853	2.75	2.85
125 D	2,800	2.75	2.80
Class "A" Concrete	Cu.yds.	....	
28 REO (Bridges)	374.4	20.50	.....
(Culverts)	36.6	25.00	.....
122 A (Bridges)	826	19.50	23.00
	227	22.25	24.00
125 C	499	23.75	23.00
125 D	40	23.00	23.00
Class "B" Concrete			
122 A	190	18.50	22.00
125 C	226	22.75	22.50
125 D	316	18.00	21.50
Surfacing One Course			
125 C (selected)	46,931	1.35	1.42½
125 D (gravel)	17,922	1.25	1.64

Lowest Bids for Street Work Received by Long Beach, Calif., During 1926 and 1927

Street Paving	July 1, 1926 to July 1, 1927	July 1 to Dec. 31, 1927
6" Concrete, per sq. ft.	$0.190	$0.210
7" Concrete, per sq. ft.	.240	.237
8" Concrete, per sq. ft.	.245	.270
9" Concrete, per sq. ft.	.301	....
10" Concrete, per sq. ft.	.279	.284
8" Conc. base, bit. protective coat	.254	....
2" asphalt top, 6" conc. base	.252	....
2" asphalt, 8" conc. base	.300	....
6" asphalt concrete	.190	....
5" asphalt concrete	.170	....
Resurfacing, asp. conc. per sq. ft.	.108	.1557
Resurfacing, asphalt conc. per ton	5.75	5.75
Alley Paving		
6" concrete	.232	.22
8" concrete	.270	.25
Grading and oiling, per sq. ft.	.088	....
Cement Gutters		
6" gutters, per sq. ft.	$0.22	....
7" gutters, per sq. ft.	.26	$0.26
8" gutters, per sq. ft.	.25	.28
10" gutters, per sq. ft.	.30	....
Combined Curb and Gutter		
Per lineal foot	.80	.90
Cement Curb		
Per lineal foot	.42	.42
Curb Armor		
Per lineal foot	.38	.38
Sidewalks		
Cement sidewalks, per sq. ft.	.138	.138
Cross Walk		
Per square foot	.18	.18

The low bids for the year July 1, 1926 to July 1, 1927 averaged 7.8 per cent. below the averages of all bids. For the last half of 1927 the low bids averaged 1.9 per cent. below the averages of all bids. Omitting the asphalt, these percentages become 14 and 4½ respectively.

Recent Legal Decisions

NO DAMAGES FOR DELAY IN SECURING RIGHT OF WAY UNDER CONTRACT PROVISION

Where a road construction contract contained a stipulation that the contractor should have no claim against the city for damages or loss of profit caused by the city's failure or inability to obtain the required right of way, the Maryland Court of Appeals held, Christhilf v. Mayor and City Council of Baltimore, 136 Atl. 527, that the contractor could not recover for the city's negligent delay in securing the right of way.

SUBCONTRACTOR'S RIGHT TO WORKMEN'S COMPENSATION UNDER AGREEMENT WITH PRINCIPAL ROAD CONTRACTOR

Where a compensation insurance contract issued to an original contractor, in this case a road contractor, insures against such obligations to pay compensation as may be imposed by law, and also against such obligations to pay compensation as may be accepted by the contractor, the Oklahoma Supreme Court holds, Brooks v. A. A. Davis & Co., 254 Pac. 66, that the scope of the insurance contract is broadened to the extent of rendering the insurance company liable for compensation to such persons as may be accepted by the original contractor as employees, where such persons are injured in the course of hazardous work conducted by the original contractor. This applies to a subcontractor who has been induced by the original contractor not to carry compensation insurance on the understanding that he report his pay roll to the original contractor, who will pay the premiums based on the pay roll and charge them back to the subcontractor, and the subcontractor, doing hazardous work for the original contractor, includes himself at a daily wage in his reports along with his employees.

CLAIM FOR EXTRA WORK NOT PRESENTED BEFORE SETTLEMENT DISALLOWED

The Louisiana Supreme Court holds, Heines & Peterson v. Prutsman, 162 La. 587, 110 So. 765, that after a settlement in full between a contractor and subcontractor for all work done under the contract the subcontractor cannot recover for extra work alleged to have been done prior to such settlement, especially where the claim for such work was not presented in the manner provided by the contract between the highway commissioners and the principal contractor, which contract was made a part of the subcontractor's contract, no error or fraud being alleged.

COMPENSATION FOR LAND CONDEMNED FOR STATE ROADS

The Florida Supreme Court holds, Spafford v. Brevard County, 110 So. 451, that before condemnation of land by the state road department for public roads, full compensation ascertained by a jury must be paid or secured. The statute does not authorize the department to use lands sought to be condemned for road purposes on deposit of twice the value as fixed by the circuit judge on affidavits as to such value.

ROAD CONTRACTOR NOT RESPONSIBLE FOR DEFECTS DUE TO PLANT AND SPECIFICATIONS

In an action to recover the balance due for the construction of certain roads, the plaintiff alleged that he was engaged to construct the roads "according to the plans of the defendants therefor," and there was evidence tending to show that defects in the construction complained of by the defendants were due to defects in the defendants' plans. The Florida Supreme Court held, McRainey v. Langston, 110 So. 536, that it was not error for the trial court, at the plaintiff's request, to instruct the jury as follows: "You are further instructed that, where a builder performs his work strictly in conformance with plans and specifications, he is not liable for defects in the work due to such plans and specifications, and he may recover in such case where the contract is performed."

Where, in such a case, the defendants pleaded a failure of the plaintiff to construct the roads according to an alleged contract, and that, because of said breach of contract, defendants were compelled to employ another to put the roads in the condition they were required to be placed in under the contract, but did not ask recompense for amounts paid such third party, nor plead a set-off therefor, it was not error for the trial court to refuse to admit testimony as to the amount paid for the completion of the work.

COMPETITIVE BIDDING; USE OF SPECIFIED PRODUCT

While there is conflict of opinion in various jurisdictions on the point, the Kentucky Court of Appeals holds, City of Springfield v. Haydon, 288 S. W. 337, that a paving ordinance requiring the use of a rock asphalt of a certain company engaged in mining the rock and selling it on the open market, and not in the street construction business, did not deny competition so as to be invalid, the company having no interest in the bids or the work, and three responsible bids being received.

It was also held within the discretion of the City Council to take a bond of $12,000 for a paving contract of over $57,000, where the work was to be accepted block by block, and the contractor was to be paid nothing until it had been so accepted.

HIGHWAY COMMISSIONER NOT LIABLE FOR INSECURE BRIDGE HE IS WITHOUT FUNDS TO REPAIR

A highway commissioner who in good faith and to the best of his ability has expended the means at his command to keep a bridge under his jurisdiction in good repair, cannot be held liable for injuries caused by its insecurity which he did not have the funds to repair, even though he knew the bridge was in need of repair. Hickman v. Thacker, 341 Ill. App. 402.

INDORSEMENT OF APPROVAL OF PLANS AND SPECIFICATIONS FOR PUBLIC BUILDING

Section 451 of New York Education Law provides that no schoolhouse shall be erected at an expense exceeding $500 until the plans and specifications have been indorsed with the approval of the commissioner of education. A schoolhouse was erected at a contract price of $2,860.67. In an action for a balance of $660.67, the defense was that the plans and specifications had not been so indorsed until after the contract was completed. The New York Appellate Division, Benedict v. Van Dusen, 223 N. Y. Supp. 152, held the defense to be without merit. The court said, in part: "The statute does not forbid the making of a contract for the erection of a school building, nor does it forbid payment for a school building already erected, even though the written indorsement of the commissioner of education has not been secured, nor does it forbid the use of such a building after it is erected. The only prohibition of the statute runs against the erection of the building. The building already having been erected, its erection cannot be restrained. . . . The plaintiff entered into this contract upon the invitation of the defendant, and in good faith performed. He had a right to assume that the defendant was presenting to him a valid contract, which he had a right to perform. If there has been any omission to comply with the statute it is the omission of this defendant, or of the education department. The defendant should not be allowed to take advantage of its own wrong; it has not hesitated to avail itself of its advantage."

UNAUTHORIZED CITY WARRANT HELD UNCOLLECTABLE

Under Florida Rev. Stat. 1920, sections 1828, 1895, the government of a city cannot make appropriations in any one year for a greater sum than is allowed to be collected by taxation. A warrant was issued by the mayor and city clerk of a town evidencing an indebtedness for salary for which there was no appropriation, and the issue of which was not authorized by the municipality's governing body. It was held that no action could be maintained upon the warrant by a purchaser for value without notice of any illegality or irregularity in the warrant. Warrants or drafts upon the treasurer of a municipal corporation can be issued only in the manner and for the purposes prescribed by law, failing which they cannot be collected. Warrants or orders drawn by one or more municipal officers upon another in the payment of a municipal indebtedness, are, by the weight of authority, not to be regarded as negotiable or commercial paper cutting off equities against the municipality.—Town of Bithlo v. Bank of Commerce, Florida Supreme Court, 110 So. 837.

PROCEDURE IN ANNEXATION OF TERRITORY BY MUNICIPALITY

Under the Kansas statute giving a city of the second class power to annex adjacent territory by ordinance where it is subdivided into lots and blocks, territory which has been plotted into acre and ten-acre tracts, without streets or alleys running through it or around it, cannot be annexed in this manner.—Brown v. Junction City, Kansas Supreme Court, 251 Pac. 726.

CONDITIONAL PURCHASER OF MUNICIPALITY'S ELECTRIC PLANT HELD NOT LIABLE FOR TAXES

Where a city sells its electric plant, the contract (embodied in an ordinance) providing that the city shall hold title until all payments are made and in case of any default may take possession of the property and operate it as its own, but if all the payments are made at the times specified the title shall thereby pass to the purchaser without further action, the Kansas Supreme Court holds, Kansas Power Co. v. Board of Commissioners of Smith County, 251 Pac. 114, that both the legal and equitable title remain in the city, and the prospective purchaser is not liable for taxes as the owner of the property. The plant, as such, is not taxable, because property owned by the city is exempt.

EFFECT OF TOWN'S PERMIT FOR CONSTRUCTION OF CITY GARBAGE DISPOSAL PLANT

The New York Appellate Division holds, Schwab v. Graves, 223 N. Y. Supp. 160, that the grant by a town of a permit for the construction of a city garbage disposal plant was not a valid consideration for the release by the city of the town's contract obligation for the right to use the city sewage system for disposal of the town's sewage. The town board, in granting the permit and in imposing terms and conditions for the exercise of its right, was not acting in a private capacity, but under its police power, which is not subject to limitation by private contract. In respect to subjects coming within its legislative power to promote the welfare, health, comfort and security of its inhabitants, it had nothing to sell, and it could not limit its further action as to these things, whatever permit it granted.

CONTRACTOR ENTITLED TO INTEREST ON MONEY USED IN COMPLETING SUBCONTRACTOR'S CONTRACT ON LATTER'S DEFAULT

A construction company was held entitled to recover from the surety on a subcontractor's bond interest on the amount the construction company was required to use in completing the contract over and above the amounts it received in current payments. If the condition of the bond had not been broken the construction company would have had the use of its money; and interest is the compensation allowed by law, or fixed by the parties, for the use or detention of money.—New Amsterdam Casualty Co. v. W. T. Taylor Const. Co., C. C. A. Fifth Circuit, 21 Fed. (2nd) 1002.

UNCONDITIONAL PAYMENTS TO CONTRACTOR

In Minnesota the law is well settled that, where payments are made unconditionally to a public contractor under a contract providing for retained percentages and payment on the architect's certificate, the contractor can use the money paid in any way he desires, and the payment is not subject to any equity.—Fidelity & Deposit Co. v. Union State Bank, 21 Fed. (2nd) 102.

VALIDITY OF "MULTIPLE DWELLING" ZONING ORDINANCE

In actions involving the validity of a zoning ordinance creating a "multiple dwelling" district, and forbidding the erection therein of factory buildings or additions thereto, the federal district court for Minnesota, Fourth Division, held American Wood Products Co. v. Minneapolis, 21 Fed. (2nd) 440, that such an ordinance must find its justification in some aspect of the police power, asserted for the public welfare. A regulatory zoning ordinance which would be clearly valid as applied to the great cities might be clearly invalid as applied to rural communities (Village of. Euclid v. Ambler Realty Co., 272 U. S. 365). If the validity of the legislative classification for zoning purposes be fairly debatable, the legislative judgment must be allowed to control. The mere fact that the ordinance is harsh and seriously depreciates the value of the complainant's property is not enough to establish its invalidity.

Although of opinion that it is unjust for a city to limit the use of property so as to seriously affect its value where the city may under legislative authority establish a restricted residence district to include the property and secure compensation for injury done thereto, the federal court declined to interfere with the local authority's judgment, especially where it is upheld by the state Supreme Court, where it is not plain that the ordinance has no real or substantial relation to the public health, safety, morals, or to the general welfare.

SPECIFICATIONS HELD WARRANTY AS TO FORMATION OF EXCAVATION WORK

A provision in the specifications prepared by a railroad for a tunnel that "Part of the tunnel excavation at each end is expected to be in rock formation, and the remainder in solid rock "was held to constitute a representation or assurance on the part of the railroad company upon which the contractor had a right to rely, since the only purpose of the statement must have been to influence bidders and affect bids. If the specifications were ambiguous, as they were prepared by the railroad company, they were to be construed against it. When it was found that the formation was chiefly fine, loose sand, and the railroad company instructed the contractor to proceed, the latter was held entitled to recover for the additional cost on the theory of implied contract. Drawings prepared by the railroad's engineers, after discovering the difference in the formation, were held sufficient to meet a clause in the contract requiring extra work to be authorized in writing.—Sartoris v. Utah Const. Co., C. C. A. Ninth Circuit, 21 Fed. (2nd) 1.

WHETHER DRAWING SHOWING DEPTH OF BEDROCK A WARRANTY HELD FOR JURY

A contract for the construction of a bridge had attached a drawing or diagram containing lines and figures which required the testimony of expert engineers and contractors to aid in the determination of whether the lines and symbols were equivalent to positive assertion or representation that bedrock would be found at a given depth. This testimony being conflicting, it was held, Phoenix Tempe Stone Co. v. De Waard, C. C. A, Ninth Circuit, 20 Fed. (2nd) 757, that the question as to whether they did constitute such a representation as the subcontractor had a right to rely upon without investigation was for the jury.

ITEMS COVERED AND NOT COVERED BY MISSISSIPPI PUBLIC WORKS BOND

In an action by materialmen against the original contractors for road construction, their subcontractors and the surety on the original contractor's statutory public works bond, the Mississippi Supreme Court held, McElrath & Rogers v. W. G. Kimmons & Sons, 112 So. 164, that repairs on the contractor's equipment are not secured by such a bond, nor the purchase price of machinery which comes under the head of equipment. Where the contract with the employees is for wages and board, the bond may cover necessary food supplies at the camp, if it is not operated for profit, and the amount for food does not exceed the actual cost. Clothes, cigarettes, tobacco, notions and cash furnished to laborers by third parties are not recoverable under the bond required by the Mississippi act, nor furniture and household effects supplied the contractor to maintain the camp.

Obligors, obligees, and sureties of the Mississippi statutory bond are presumed to know of the required obligation to pay laborers and materialmen promptly, and although the bond is silent as to this obligation it will be read into it.—Commercial Bank of Magee v. Evans (Miss.) 112 So. 482.

ROAD CONTRACTOR NOT LIABLE FOR INJURY BY NEGLECT TO DO BACK FILLING UNDERTAKEN BY COUNTY

The Texas Commission of Appeals holds, T. J. Mansfield Const. Co. v. Gorsline, 288 S. W. 1067, reversing 278 S. W. 485, that a construction compay which had installed culverts in a highway under a contract which required the county to do the back filling was not liable for injuries sustained by an automobilist after the construction company's work had been completed and accepted by the county, due to the fact that the back filling of one of the culverts by the county had not been completed.

TAX BILLS FOR SEWER WITHOUT PROPER OUTLET HELD VOID

Where a sanitary district sewer had no proper outlet, as required by Missouri Rev. St. 1919, §8779, but emptied into an artificial ditch not under the city's control, it was held that tax bills issued to cover the expense of constructing the sewer were void.—City of Chillicothe v. Pennington (Mo. App.) 288 S. W. 939.

JURISDICTION TO ADJUST MATTERS ARISING OUT OF BONDED CONTRACTOR'S DEFAULT

Equity has jurisdiction of the suit of a construction contractor's surety which took over the completion of the contract on the contractor's default, to adjust all matters arising out of the contract, including the claims of various lienors, the right to certain funds, and an accounting therefor.—Maryland Casualty Co. v. Board of Water Comn. of Dunkirk, 21 Fed. (2nd) 1005.

NEWS OF THE SOCIETIES

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. Fourteenth annual convention at El Paso, Tex. M. E. McIver, Chicago, Sec'y.

June 5-7—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS OF THE STATE OF NEW YORK. Annual meeting at Troy, N. Y. W. P. Capes, City Hall, Albany, N. Y.

June 11-16 — AMERICAN WATER WORKS ASS'N. Annual meeting at San Francisco, Calif.

June 25-29—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting at Atlantic City, N. J.

Sept. 18-20—INTERNATIONAL CITY MANAGERS' ASSOCIATION. Annual convention at Asheville, N. C. John G. Stutz, Lawrence, Kans.

Oct. 15-19 — AMERICAN PUBLIC HEALTH ASS'N. Annual meeting at Chicago, Ill. Homer N. Calver, 370 Seventh Ave., New York City.

Oct. 16-17—NATIONAL MUNICIPAL LEAGUE. Annual meeting at Cincinnati, O. H. W. Dodds, 261 Broadway, New York City.

Oct. 22-26—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention at Detroit, Mich.

AMERICAN ROAD BUILDERS' ASSOCIATION

The standardization of county road building and maintenance methods will be the main objective of a conference of county highway officials to be held at Washington, D. C. on May 12th, which will be the first annual meeting of the County Officials' Division of the American Road Builders' Association. The meeting will be held following the general sessions of the American Road Builders' Association on the preceding day. Thomas J. Wasser of Jersey City, N. J., president of the County Officials' Division, will preside over the meeting. Other officials of the Division are: Vice-president Charles E. Grubb of Wilmington, Del.; Vice-president John Kirkpatrick, Benton, Ark.; Vice-president Edward N. Hines, Detroit; Vice-president Stanley Abel, Taft, Cal.; Treasurer James H. MacDonald, New Haven, Conn.; Secretary Charles M. Upham, Washington; and twenty-eight directors.

AMERICAN WATERWORKS ASSOCIATION

Following is a partial list of papers and topics of discussion to be presented at the 48th Annual Convention of the American Waterworks Association, which will be held at San Francisco, June 11 to 15.

Chlorination on the Pacific Coast, by W. J. Orchard, Wallace & Tiernan Co.; Coefficients of Electrolytic Corrosion of Brass and Copper Pipes, by K. H. Logan, U. S. Bureau of Standards; The Pitot Tube in Water Works Practice, by Geo. D. Conlee, Republic Flow Meter Co., Failure of a 48-inch Cast Iron Main under Earth Pressure, by W. W. Brush, chief engineer, Dept. Water Supply, N. Y.; A State Water Policy for California, by Edward Hyatt, state engineer; Reforestation of Watersheds, by Edgar P. Kable, York Water Co., York, Pa.; Unaccounted for Water, by L. R. Howson; Campaigns to Increase Water Sales, by L. W. Britton, associate editor, Domestic Engineering; Financing of Extensions in Territory only Partially Remunerative at Time of Construction, by C. L. Fox, Pennsylvania Water Co.; Choosing Pumps to Fit Service Conditions, by F. G. Cunningham; Coefficients of Flow in Concrete Pipe, by F. C. Scobey, U. S. Dept. of Agriculture, discussion by F. F. Longley, Lock Joint Pipe Co.

Control of Stresses in Pipe Line Construction, by L. F. Jones, professor of physics, and Walter S. Weeks, Professor of Mining, University of California, Berkeley, Calif.; Softening of Municipal Water Supplies by Use of Zeolite, by J. T. Campbell, and D. E. Davis, The J. N. Chester Engineers, Pittsburgh, Pa.; Protection of an Impounded Water from Pollution by Oil Field Water and Highly Mineralized Irrigation Water, by N. T. Veatch, Black & Veatch, consulting engineers, Kansas City, Mo.; Interstate River Compacts and Their Place in Water Utilization, by Delph E. Carpenter, interstate river commissioner for Colorado, Greeley, Colo., and R. I. Meeker, consulting engineer, State Capitol Bldg., Denver, Colo.; Colorado River Water Supply for the Los Angles Metropolitan District, by Wm. Mulholland, chief engineer, Bureau of Water Works & Supply, Los Angles, Calif.; San Francisco Water Supply, by G. A. Elliott, vice president and chief engineer, Spring Valley Water Co., San Francisco, Calif.; Relative Merits of Pipe Line Materials and Coatings, (Including Progress Reports of various Committees having these matters in hand).

Prospective Papers include Holding Companies, Protection of Impounded Watersheds and Water Supply Conduits, and Standardization of Steel Tanks for Water Works Service.

Papers of the Water Purification Division Sessions include: The Chemical Reactions of Sodium Aluminate, by A. M. Buswell, chief, State Water Survey Division, Urbana, Ill.; Notes on Engineering Studies of Municipal Zeolite Water Softening, by H. N. Jenks, associate professor of sanitary engineering, Iowa State College, Ames, Iowa.; Alagae Control by Chlorination, Kansas City, Kans., by L. B. Mangun, chemist in charge of water purification, Kansas City, Kans.; Progress in Water Chlorination During 1927-28, by L. H. Enslow, Chlorine Institute, New York, N. Y., Discussion by C. M. Everett, Hazen & Whipple, Consulting Engineers, New York, N. Y. and N. J. Howard, bacteriologist, Filtration Laboratories, Toronto, Ont.; Operating Experiences with the East Bay Filtration Plants, by Professors W. F. Langlier and Joseph DeCosta, University of California, Berkeley, Calif.

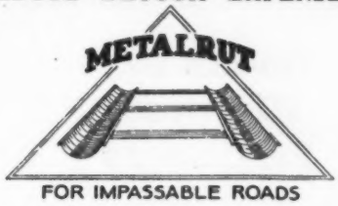
How Standard Are Standard Methods? by L. L. Jenne, sanitary engineer, Bureau of Water, Chester, Pa.; Operating Experiences with the Sacramento Filters, by R. A. Stevenson, superintendent, Filtration Division, Sacramento, Calif.; Experiences with Crenothrix in Ground Water Supplies, by Kenneth W. Brown, sanitary engineer, California Water Service Co., Stockton, Calif.; Hydrogen Sulphite Removal and Water Softening at Beverly Hills, by R. L. Derby, sanitary engineer, Los Angles, Calif.; Experiences with Covered and Uncovered Reservoirs at Washington, D. C., by C. J. Lauter, chief chemist, Filtration Plant, Washington, D. C.; Chloro-phenol Tasts from Creosoted Wood Stave Pipe in Colorado, by Dana E. Kepner, director, Division of Sanitary Engineering, State Board of Health, Denver, Colo.

Prospective Papers for this Session include: The Bacteriophage in Relation to Water Supplies, by Professor M. S. Marshall, University of California, Berkley, California; Modified Confirmation Tests for B Coli, by Dr. A. J. Salle, University of California, Berkley, Calif.; Improved Quantitative Method for Phenols in Water Supply, by John R. Baylis, Chicago, Ill.; Design and Performance of Circular Mixing Basins at Knoxville, Tenn., by Alvord & Burdick, consulting engineers, Chicago, Ill.; Plankton in Reservoirs, by Professor C. A. Kofoid, University of California, Berkeley, Calif.

The Superintendents' round table discussion covers these topics: A New Band for Large Cast Iron Pipe, by W. W. Brush; Hydrants and Valves, by J. I. Prugh, superintendent of Water, Sacramento; Dead Ends, by S. B. Morris, chief engineer Water Dept., Pasadena; Leak Surveys, by V. E. Perry, Spring Valley Water Co., San Francisco; Standpipes, Tanks and Reservoirs, by J. S. Peters, Marin Municipal Water District, San Rafael.

A practical field demonstration of Modern Water Works practice will be given during the week by employees of local water supply organizations. A

REDUCE DETOUR EXPENSES



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This handbook offers a compact treatment of the problems of highway location with special emphasis on the subject of curves and earthwork, including the banking and widening of pavements. The economic and aesthetic advantages of easement spirals are fully explained and a large variety of original tables are presented to facilitate the layout of these curves. 382 pages, pocket size, flexible, $3.50.

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reception and dance will be held on Monday night and a theatre party for the ladies and smoker for men on Wednesday night. A dinner dance will be held Thursday night.

AMERICAN ROAD BUILDERS' ASSOCIATION

The directors of the American Road Builders' Association, acting upon the request of several city officials, have authorized the formation of a City Officials' Division of the American Road Builders' Association. The division will be governed by its own constitution and by-laws and will elect its own president, vice-presidents and directors. It will retain the identity of a city officials' organization, but will remain a division of the American Road Builder's Association. In addition to the president, vice-presidents and directors, the division will operate through contact men located in all the principal cities of the country.

The policy of the division for the present will be to apply itself to the street and highway problems of cities. There will be several committees appointed, made up of city officials from different cities throughout the United States, and the reports of these committees will be presented on City Officials' Day at the next convention.

There are many problems within the cities which are still demanding the best attention of engineers. With the formation of the City Officials' Division, it is expected that many details which now lack agreement will soon be standardized.

The organization meeting for the City Officials' Division will be held the early part of June at the headquarters of the association in Washington. It is urged that all city officials attend and take an active part in the affairs of the division.

SECOND ANNUAL CONFERENCE, MARYLAND WATER AND SEWERAGE ASSOCIATION

The Second Annual Conference of the Maryland Water and Sewerage Association was held in Baltimore on April 10 and 11. The attendance was 163. The first day of the Conference was devoted to papers and discussions on water and sewage problems. During the morning of the second day papers on sewage and trade waste treatment and swimming pool sanitation were delivered. The afternoon was spent in making an inspection of the Towson sewage treatment works and of one of Baltimore City's refuse incinerators.

An Executive Committee of five members in addition to the officers of the Association was established. The newly elected officers are:

President, F. H. Dryden, Chief Engineer, Salisbury Water and Sewer Commission; 1st Vice-President, C. A. Hechmer, Department Engineer, Washington Suburban Sanitary District; 2nd Vice-President, Albert Heard, Superintendent, Hagerstown Water Board; Treasurer, Edward S. Hopkins, Sanitary Chemist, Baltimore City Water Department; Secretary, T. C. Schaetzle, Senior Assistant Sanitary Engineer, Maryland State Department of Health.

At the morning session R. B. Morse, Chief Engineer of the Washington Suburban Sanitary District, and V. B. Siems, Vice-President and General Manager of the North American Water Works Corporation, presented papers on the private and public ownership of water systems. These were discussed by H. Carl Wolf, Chief Engineer of the Maryland Public Service Commission. T. S. Durham's paper pointed out the necessity for careful cost accounting for determining the actual cost of water systems to a municipality. Another paper of interest was that by F. H. Dryden on "Fire Insurance Savings and Water Works Design." Mr. Dryden stated, in his conclusions, that "while the water supply system is the fundamental basis for all protected fire insurance rates, it represents only 1,700 points of the 5,000 deficiency points set up in the grading schedule of the National Board of Fire Underwriters. The other deficiencies are charged against the fire departments, fire alarm systems, building laws, hazards and structural conditions." The writer urged proper co-ordination of these various units to secure the best insurance rates. The fire insurance savings indicated by Mr. Dryden as due to the installation of water works were amply confirmed in the discussions by Messrs. Walden, Munroe and Morse.

The operation phases of water treatment were considered by L. H. Enslow and J. G. Patrick, who discussed the various methods for the determination of residual chlorine and the value of this test in plant operation. Mr. Enslow's paper indicated that the orthotolodin method is the most satisfactory for the usual plant.

The industrial uses of water were considered in a paper dealing with the water problems arising in stationary steam practice by William Krumbine and the treatment of water for railroad purposes by R. C. Bardwell of the Chesapeake and Ohio Railroad. Mr. Bardwell stated that the total annual water consumption by American railroads will average 500,000,000,000 gallons, of which approximately 350,000,000,000 gallons are used for steam purposes. To show the magnitude of the railroad problem, Mr. Bardwell stated further that it requires 15,000 water stations to produce this supply which involves an investment of $300,000,000 in facilities and an annual expense of $50,000,000 for operation and maintenance. There are about 70,000,000 gallons of water treated annually, removing 140,000,000 pounds of scale forming matter, which would have lodged on tubes and sheets of the boilers had the water not been treated. He stated further that about 80 percent of the water used for steam purposes could be treated to advantage, but that at present only 20 percent is treated.

M. J. Ruark's paper on Sewer Maintenance considered maintenance due to depreciation, the misuse of sewers, the disposal of snow, oil and gasoline. He pointed out the esential features of some

(*Continued on page* 40)

NEW CATALOGS

Ingersoll-Rand Co., N. Y. A 12-page illustrated catalog describing portable air compressors, rock drills, paving breakers, hoists, clay diggers, pneumatic tools and hose.

Colo-Diesel, N. Y. An illustrated folder describing small airless injection Diesel engines.

Crouse-Hinds Co., Syracuse. Traffic signal catalog describing and illustrating all types of signals equipment and installations.

Hawkeye Maintainer Co., Waterloo, Ia., 24-page illustrated catalog describing Hawkeye road maintainers.

General Electric Co., Schnectady, N. Y. A 16-page catalog describing electric apparatus for use with the Cottrell precipitation process.

Good Roads Machinery Co., Kennett Square, Pa. A 16-page illustrated catalog describing motor graders adaptable for light traction such as the Caterpillar, Cletrac and McCormick-Deering.

The Aldrich Pump Co., Allentown, Pa. A 16-page illustrated catalog, No. 70, describing Aldrich double suction volute centrifugal pumps.

Asphalto-Concrete Corp, N. Y. A 26-page illustrated catalog describing drain and pressure pipes of concrete with asphalt lining and surfacing; and poles and conduits.

Lufkin Rule Co., Saginaw, Mich. A 166-page illustrated catalog (No. 11) describing a wide variety of measuring tapes, rules and mechanical tools.

Interflash Signal Corporation, New York. An 8-page bulletin summarizing the best ways of safeguarding all types of highway cross-roads.

American Fin-Mix Co., Chicago, Ill. Illustrated folder describing the Finley Rotary pressure mixer for laying asphalt pavements.

Lincoln Electric Co., Cleveland, O. 26-page illustrated catalog describing Linc-Weld motors.

Hiler Engineering and Construction Co., Brooklyn, N. Y. An illustrated 24-page booklet describing Heenan municipal refuse incinerators, and furnishing data regarding a number of installations.

Celite Products Co., Los Angeles, Calif. Bulletin 336. 8 pages, illustrated. "Designing Concrete for Workability as well as Strength."

Frederick Iron & Steel Co., Frederick, Md. Illustrated leaflet describing Frederick diaphragm pumps.

Frederick Iron & Steel Co., Frederick, Md. 22-page illustrated booklet describing Frederick centrifugal pumps.

H. W. Caldwell & Son Co., Chicago, Ill., Screw Conveyor Book No. 989, 85 pages, illustrated, describing screw conveyors, and giving prices and dimensions. This company is a subsidiary of the Link-Belt Co., Chicago, Ill.

John J. Stein & Son, Brooklyn, N. Y., Catalog No. 27, 36 pages, illustrated. Describes Stein bilge pumps, strainers, stacks, flues, tanks, sump pumps and riveted flanged pipe.

Jaeger Machine Co., Columbus, O., a 40-page catalog, T-28 in two colors, describing Jaeger concrete mixers.

Silent Hoist Winch & Crane Co., Brooklyn, N. Y. Bulletin No. 27, 4 pages, illustrated, describing different types of vertical and horizontal capstan winches and double drum winches, either electric or gasoline drive.

Biggs Boiler Works Co., Akron, O. An 8-page illustrated folder in two colors describing Biggs steel pipe and illustrating a number of installations. Also discussing the qualities of steel pipe.

Standard Steel Works, North Kansas City, Mo. Catalog No. 201, 16 pages, illustrated, describing "Tar Baby" heater for road and street and other work.

Widening the Telephone Horizon

An Advertisement of the American Telephone and Telegraph Company

IN THE memory of many now living, Alexander Graham Bell made the apparently rash prediction that the day would come when we could talk to other countries, even across wide expanses of water. That was shortly after the historic conversation between Boston and Cambridge, a distance of two miles.

Bell's vision was made a reality when in 1926 New York and London spoke together in two way conversation, and when in 1927 this service was opened to the public between any point in the U. S. A. and Great Britain. Since then, Mexico has been brought into speaking distance; important cities of continental Europe have come within the voice horizon of the United States.

Even more important, the Bell System in the United States now embraces 18,500,000 telephones—a growth for the past year of more than 750,000.

We may now converse with each other from practically any point in this country to any other, and may talk beyond our borders and across the sea. That is measurable progress in widening America's telephone horizon.

(Concluded from page 38)

of the cleaning tools and stated that the total cost of maintaining 1,560 miles of sanitary sewers and storm drains in Baltimore during 1927 was approximately $158,000. The relative annual costs for the sanitary sewer maintenance were $65.50 per mile as against $165 a mile for the drains.

A description of the recently constructed sewage treatment works at Gaithersburg was presented by H. R. Hall. This plant is of the usual sprinkling filter type with sedimentation before and after the sprinkling process, together with separate sludge digestion. The primary and final sedimentation tanks are a modified form of Imhoff construction. Sakers and Zimmerman discussed laundry wastes and stated that treatment with iron and lime followed by sedimentation and filtration through a cinder bed is satisfactory and economical.

The concluding paper was delivered by M. H. Coblentz on Swimming Pool Sanitation. The author presented a score card used by the City of Baltimore in grading the various city pools. He indicated that this grading has a beneficial effect in that it brings about a spirit of competition between the various individuals in charge of the city swimming pools, resulting in an improvement from 67 to 90 percent in the ratings. Bather control is difficult of enforcement. It was found that the ultra-violet ray equipment, after thorough trials, was unsatisfactory, but chlorine as a sterilizing agent has generally maintained a water quality to meet the city standards. The best method of chlorination has been found to be by use of the automatically controlled apparatus.

MASSACHUSETTS HIGHWAY ASSOCIATION ROAD SHOW

The Fourth Annual Road Machinery Show of the Massachusetts Highway Association will be held on Charles River Road near the new Cottage Farm Bridge on Wednesday and Thursday, May 9th and 10th, 1928. This is to be the largest show yet given by the Association.

FLORIDA SECTION, AMERICAN WATERWORKS ASSOCIATION

The second annual meeting of this section was held at Orlando, Fla., April 2, 3 and 4, with an attendance of 114. Jacksonville was selected as the 1929 meeting place and officers were elected as follows: Chairman, A. P. Michaels, of Orlando; Vice-Chairman, R. W. Reynolds, West Palm Beach; Directors: C. C. Brown, Gainesville; F. J. Stewart, Hollywood; F. W. Lane, St. Petersburg; Ben Tippens, Daytona Beach, and O. Z. Tyler, Jacksonville; Secretary-Treasurer, E. L. Filby, Jacksonville.

AMERICAN WATER WORKS ASSOCIATION—MISSOURI VALLEY SECTION

The 14th annual meeting of the Missouri Valley Section, formerly the Iowa Section, will be held at the Kansas City Athletic Club, Kansas City, Mo., Oct. 2-5. Jack J. Hinman, Jr., Box 313, Iowa City, Ia., is secretary.

PERSONALS

Francis C. Shenehon has resumed general engineering practice, with headquarters in the Metropolitan Bank Bldg., Minneapolis, Minn. He will specialize in water power, waterways, canals, docks, flood control, arbitration and settlement and problems of the Great Lakes.

Tribus and Massa, New York, announce the withdrawal from the general partnership of Charles G. Massa, and the continuance of practice, under the same name, of Louis L. Tribus, with whom are associated Charles Griswold Massa, John T. Fetherston, Charles R. Bettes and Quentin F. Disher.

Gen. R. C. Marshall, Jr., resigned May 1 as general manager of the Associated General contractors of America, a position which he has held for eight years. He is succeeded by D. A. Garber, of New York, the first president and one of the founders of the organization.

Gen. Marshall will become president of the Sumner Sollitt Company, Chicago. Mr. Garber, in making the change, severs his connections with the North-Eastern Construction Co., New York, of which he has been president since 1904.

C. N. Connor has been appointed chief engineer of the American Road Builders' Association. Mr. Connor, who has had wide experience as a road builder and exceptional experience as a committee worker, has recently been chairman of the Committee on Low Cost Improved Roads, operating under the Highway Research Board. Mr. Conner was graduated from Tufts College in 1908. For three years he worked as engineer in railroad construction, and later was assistant engineer with the Bureau of Public Roads in the Philippine Islands. His next position was assistant engineer with the War Department and then with the Navy Department. He then became assistant engineer with the Delaware State Highway Department, and after that was State Construction Engineer for the North Carolina Highway Commission, where he was also head of the testing and research laboratory for a brief period. During 1925 and 1926 Mr. Conner was chief engineer of the Mexican Federal Highway Commission. He is a member of several technical organizations, author of many articles in technical journals, and a contributor to Public Works.

PUBLIC REPORTS

Street Name Signs. By Adolph J. Post and George H. McCaffrey. 18 pp., 12 ill. Municipal Administration Service, 261 Broadway, New York City, 25 cts.—This pamphlet describes tests made of the visibility of different styles and sizes of letters and different color combinations of letter and background used for street name signs; also of different heights above the street and angles of vision. It also discusses the question of location of sign and matter to be placed on it. The conclusion is reached that few signs have adopted the most effective of all or even of any of the above features, and that convenience and safety of city traffic could be greatly promoted by following the recommendations. An abstract of the pamphlet is given in the April issue of *Public Works.*

Methods of Water Analysis. By W. D. Collins. 27 pp. ill. U. S. Geological survey, Washington, D. C.—The methods used by the United States Geological Survey for analysis of the mineral content of waters are described in Water-Supply Paper 596-H which has recently been issued. This 27-page pamphlet is for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents per copy.

Waters of Florida. Water-Supply Paper 596-G, by W. D. Collins and C. S. Howard of the Geological Survey, in cooperation with the Bureau of Sanitary Engineering of the Florida State Board of Health. Contains 458 analyses that show the chemical character of the waters in the different counties and incate their suitability for domestic and industrial use.

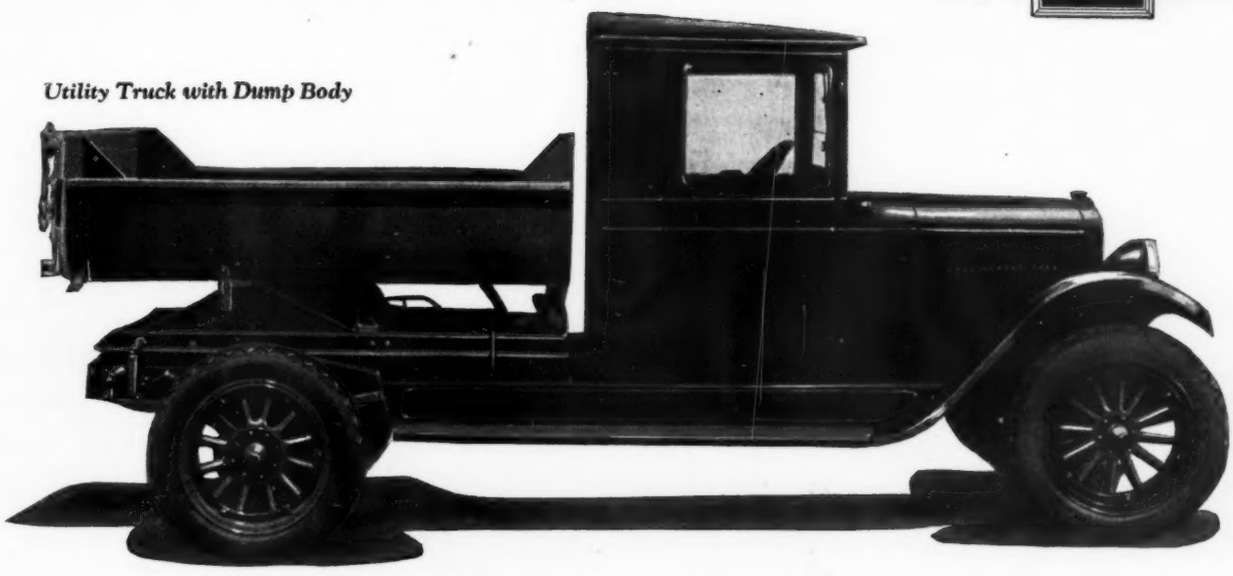
A Simple Method of Determining Stress in Curved Flexural Members. By Benjamin J. Wilson and John F. Quereau. Circular 16, Engineer Experiment Station of the University of Illinois.

Curved members subjected to bending are important elements in many engineering machines and structures. Although the ordinary flexure formula is still widely used in the design of curved flexural members, it gives values for stress that may be much too small when applied to such members. The Winkler-Bach formula has been shown to give results that agree well with the stresses found from experimental measurements of curved beams made of steel. It has, however, a serious disadvantage because of its difficulty of application in evaluating the property Z of the cross-section The use of the straight-beam flexure formula with a correction factor has frequently been suggested, but up to the present time no values for the correction factor, K, have been available, except for circular and rectangular sections. It was the object of the investigation reported in Circular No. 16 of the Engineering Experiment Station of the University of Illinois, to determine accurate values of the correction factor K for variously shaped sections and for degrees of curvature commonly found in curved flexural members. The location of a neutral axis in a curved beam, a knowledge of which is sometimes of real value, is also given for various cross-sections and degrees of curvature. Copies of Circular No. 16 may be obtained without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

for Economical Transportation

CHEVROLET

Utility Truck with Dump Body



Get Delivery on a New Chevrolet Truck NOW!

If your requirements call for a speedy, dependable haulage unit—you can get prompt delivery on a Chevrolet Truck. The thirteen great Chevrolet factories are working at capacity; and your Chevrolet dealer can provide you with exactly the body-type to meet your individual requirements.

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QUALITY AT LOW COST

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

FRESNO TRACTOR HITCH FOR DIRT MOVERS

The U. S. Factories Co., Sidney, O., has brought out a new Fresno tractor hitch, which is claimed to be a good buy for dirt movers because it is low priced; it can be used with any make of horse-drawn fresno, thereby allowing present equipment to be worn out; it operates back of any tractor without mechanical change or special attachments; one size hitch fits either a 4-foot or a 5-foot scraper. Four bolts are necessary to assemble this hitch, ready for coupling to any tractor. Control is easy. After the depth of cut has been set, only one lever—the dumping lever— needs to be moved. One pull spreads the load; a second dumps the entire load in the dumped position. It loads automatically.

LESSMANN IMPROVED HIGH LIFT LOADER

The Lessmann Loader Company, Des Moines, Iowa, has put into production an improved high-lift loader and also an improved low-lift shovel. Among the improvements are the substitution of steel for malleable iron in many of the parts, thus generally strengthening the machines; an improved clutch; cable tighteners which insure even hoisting of the bucket; anti-friction bearings; and an extra-long pinion shaft bushing of highest-grade bronze. The mechanical principle of the Lessmann Loader has been retained in the new loader and shovel. With the Lessmann all the strain of lifting does not come at the front of the tractor, as is the case with most front-end attachments; much of it comes at the pivot point of the lift, which in the case of the Lessmann, is at the center of the tractor. This means less strain on the equipment, insures better balance, and greatly reduces the tendency of the tractor to rock or pitch forward when the bucket is loaded. The Lessmann-equipped Fordson is a unit especially adapted to excavating, loading, moving materials and spreading.

AN 8-SPEED TRANSMISSION

Fuller & Sons Mfg. Co., Kalamazoo, Mich., manufactures an 8-speed transmission designed for use in motor trucks. Because of the simple design, utilizing standard parts, the extra cost of this transmission is small, but it adds to the value of truck in many lines of work. The 2-speed clutch is provided with a direct drive and one reduction, which is either 1.7 to 1 or to 2.9 to 1. The amidship transmission is furnished with direct drive on fourth speed or direct on third and overdrive on fourth. The high speed range, with the 2.9 to 1 reduction are 3.21, 1.62, 1.00 and 0.747 for forward speeds and 3.21 for reverse; the low range is 9.38, 4.52, 2.92 and 2.18 for forward speeds and 9.38 for reverse for the H model transmission and somewhat higher for the G model. With the 1.7 to 1 geared clutch, the speeds are still higher.

FRESNO TRACTOR HITCH

NEW DEVICE FOR TRAFFIC MARKING

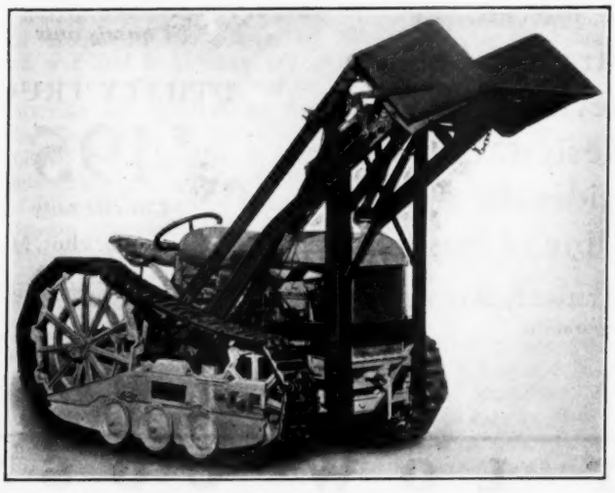
Littleford Bros. of Cincinnati, Ohio, have placed on the market a traffic line marker which they have named the Traf-O-Mark. In the accompanying illustration it is being used to center-mark a highway. It is adapted also to zone painting in cities and towns. Any make of traffic paint can be used.

The principle and construction of the machine are quite different from anything yet offered. The marking roller is made of sponge rubber with an absorbent canvas cover. This combination squeezes the paint down into all small cracks and depressions in the pavement and does not leave a glossy surface which is very undesirable, especially at night when glaring headlights are reflected. The paint supply tank has five gallons capacity; from it the paint is pumped onto the marking roller by means of a small gear pump and spread by means of a double worm spreader. One of the features of the Traf-O-Mark is the automatic speed control of this pump. The speed of the pump is in direct proportion to the speed at which the operator pushes the machine. Proper paint flow is assured at all times, resulting in a firm, even line that will not bleed.

A revolving brush in front of the marking roller cleans its path. When approaching a curb, the brush is raised out of position, allowing the marking roller to come up very close. White fibers in center of brush permit operator to follow accurately a mark or previous line.

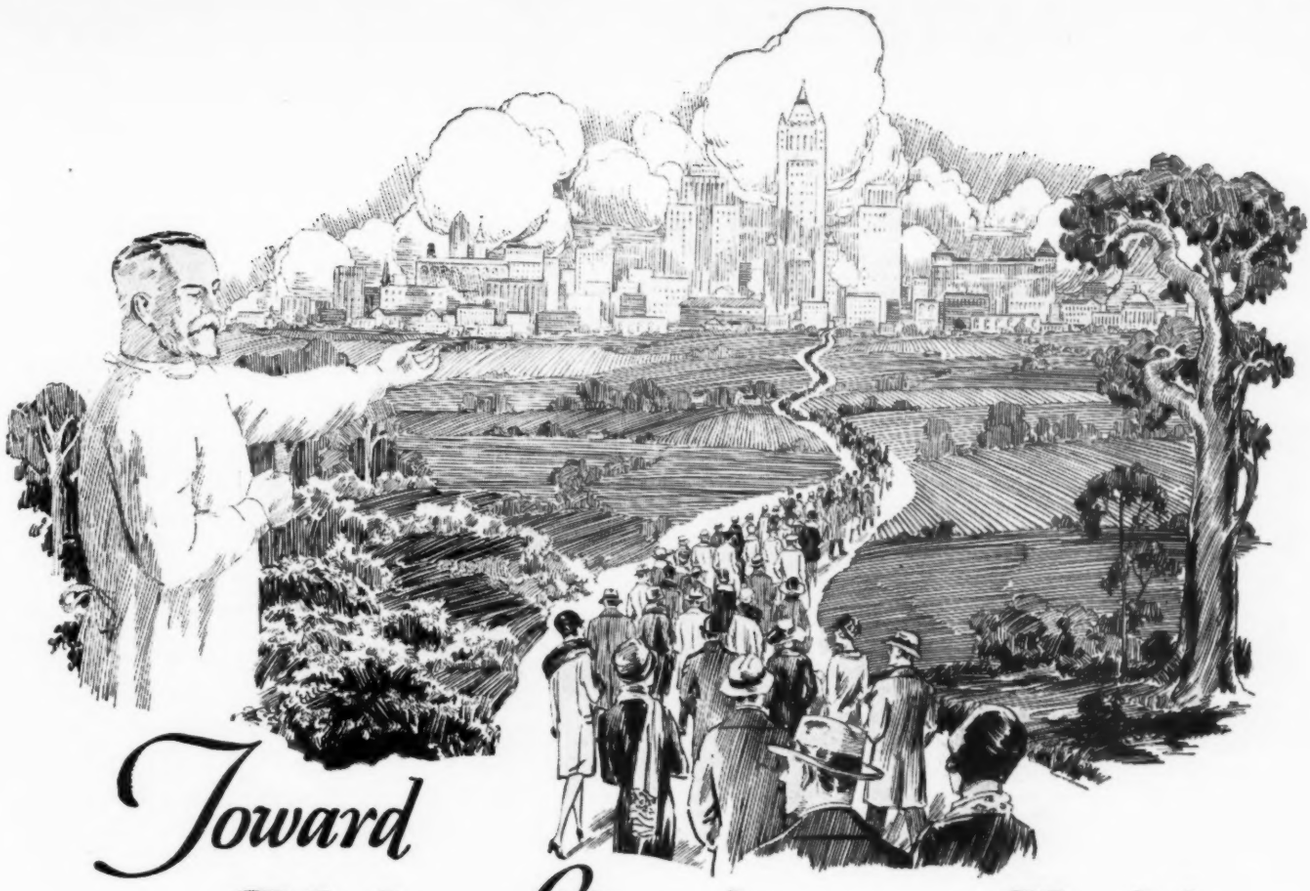
Handles are adjustable so that a man pushing the Traf-O-Mark can either straddle the marked line or walk on one side of it. Marking rollers are made in 4, 5 and 6 inch widths and are interchangeable.

While designed primarily for traffic marking, Traf-O-Mark is suitable for marking factory floors, garage parking spaces, etc.



LESSMANN HIGH-LIFT LOADER

LITTLEFORD TRAF-O-MARK



Toward Modern Cleanliness and Health

Great in the annals of medicine is the luminous name Pasteur. *He* raised the knowledge of disease out of the wallow and ruck of medieval superstition and placed the combat of it on a plane above *cupping* and *bleeding*.

He set the feet of the people on the path that led upward from the fens of pestilence, on the way that wends toward enlightenment and health.

Bartlett-Snow is proud of its contribution to the well-being of the nation. Its Sterling Destructors guard the airs of cities and save them from pollution and taint. Garbage and refuse must be disposed of! In the Sterling Destructor they are destroyed by intense fire—destroyed without offense. The products of their burning are sterile, odorless gases and a little ash—nothing but what is clean.

Our Sterling Destructor booklet tells the story at length.

THE C. O. BARTLETT & SNOW CO.
6221 Harvard Ave. Cleveland, Ohio

Bartlett - Snow

Refuse Disposal Plants

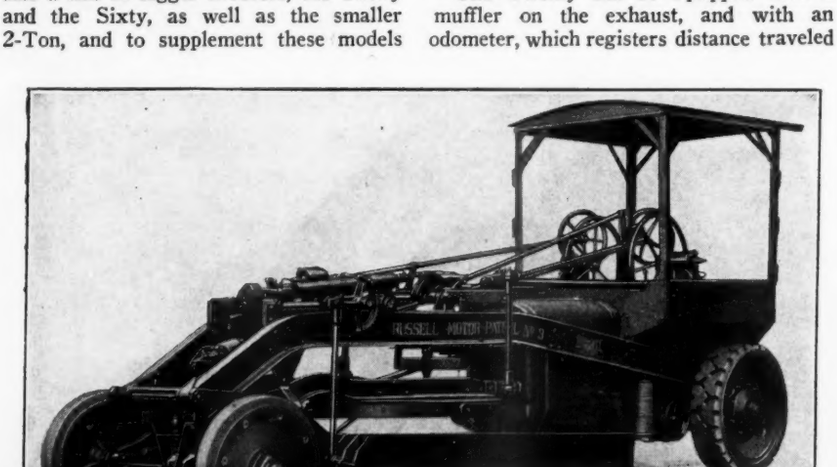
NEW CATERPILLAR "20"

The Caterpillar Tractor Co., of San Leandro, California, and Peoria, Ill., has announced a new model tractor designated as the "Caterpillar" Twenty. The new model takes its name from the fact that its rating is twenty horsepower at the drawbar. The Twenty is a new tractor in size, rating and price, built to fit into a line of bigger brothers, the Thirty and the Sixty, as well as the smaller 2-Ton, and to supplement these models in agriculture, contracting, lumbering, municipal work and in industry. A variety of special equipment is provided to meet all special requirements. Special track shoes may be ordered in place of the standard 11-inch shoes. A spark arrester offers maximum protection against possibilities of sparks coming from the exhaust. A front pull hook is available as it is often useful for pulling loads in reverse gear.

Lighting equipment includes powerful headlights, with brackets and necessary wiring. This equipment can be furnished applied at the plant, or boxed for field installation. Bracket bolt holes are tapped into radiator side plates and in the fenders at the rear of the tractor, to enable the owner to locate lights to suit his convenience. Electric starter can be supplied.

For belt work, a stationary drive can be attached to the rear of the transmission case, this unit connecting directly with the upper transmission shaft. The new model develops 25 belt horsepower. A front or rear power take-off can be provided for use with various equipment that is designed to be operated, as well as pulled, by a tractor.

The Twenty can be equipped with a muffler on the exhaust, and with an odometer, which registers distance traveled in miles. A special carburetor can be supplied when alcohol or other fuel is used. Net weight is approximately 7,000 pounds; speeds are 1.79 m. p. h. low, 3.07 intermediate, and 4.67 high, reverse, 2.26.



1928 RUSSELL MOTOR PATROL

1928 RUSSELL MOTOR PATROL

The Russell Grader Mfg. Co., Minneapolis, Minn., has brought out improved motor patrols for 1928. The principal improvements are: compensating spring lift; main circle reinforced; large universal connection at front of drawbars which eliminates all play; grip lock nuts on all bolts 3/8-inch to 7/8-inch inclusive; heavy channel frame; enclosed machined cut gears for blade and scarifier lift; ball and socket connections; moldboard reinforced by two angle irons.

Russell Motor Patrol No. 4 is powered with a 2-ton "Caterpillar" Tractor and the No. 3 with a 10-20 McCormick-Deering Tractor. Russell also builds two other models for the Cletrac and Fordson Tractors.

The weight of the No. 4, complete with tractor and scarifier attachment is 12,500 lbs.; the weight of the No. 3, complete with tractor and scarifier atachment is 12,550 lbs.

The scarifier is independently adjusted and completely controlled from the operator's platform. A Russell snow plow attachment can be furnished which makes this equipment an all-year machine.

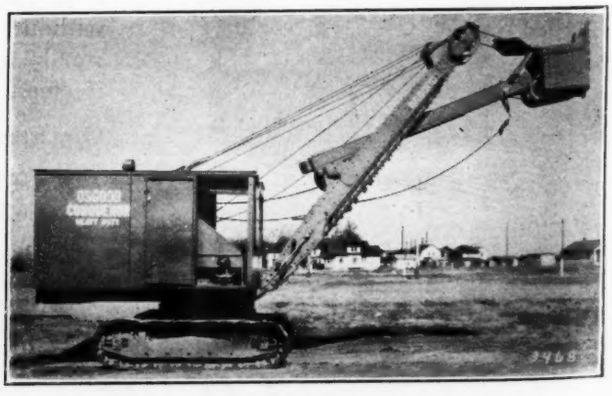
OSGOOD "CONQUEROR"

The Osgood Co., Marion, O., has just brought out the Conqueror, a new gasoline shovel of the full revolving type, fully convertible to dragline, back hoe, clam shell and crane service. This shovel is mounted upon a new and improved continuous tread truck frame of the double chain drive type. As a shovel, it carries a minimum length boom of 20 feet and a handle of 15 feet, with a back hitch type dipper; and for crane service it carries a 45-foot boom of the structural lattice bow type, with built-in tagline and with a fairlead for dragline service self-adjusting to any angle of the boom.

In changing the Conqueror from shovel to clamshell, back hoe or dragline service, no additions or changes are necessary in the operating machinery. The only changes required are those involved in changing the boom assemblies. This work may be done in the field in a few hours time.

The machine is powered by an 80 h. p., 6-cylinder gasoline motor. A special feature is the combination 75-gallon cast iron gasoline tank and counterweight which is set into the deck at the rear of the motor.

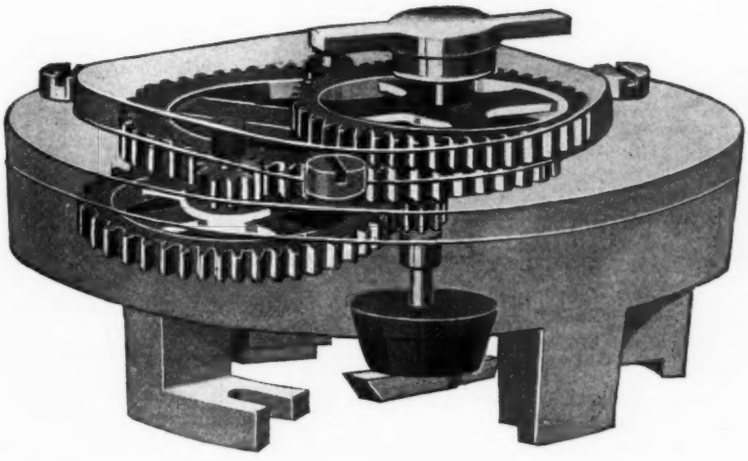
The Osgood Servo mechanism for setting the clutches on the hoisting and hold back drums, and the method of wire rope crowd which has been used by Osgood for many years, are retained in the new Conqueror. The truck is steered by means of bell crank and levers controlled from the cab at the operator's position, irrespective of the position of the upper body or of the truck frame

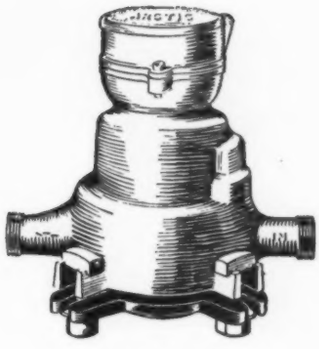


ABOVE: OSGOOD "CONQUEROR" SHOVEL

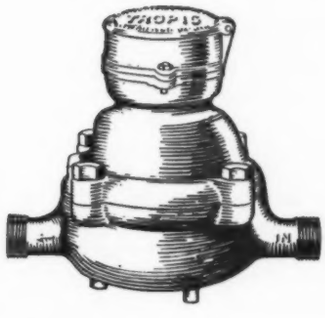
← AT LEFT: CATERPILLAR "20" TRACTOR

Protection





ARCTIC



TROPIC

COMPLETELY enclosed in separate bronze case. All parts, including case, heavily coated with tin by hot dipping process.

Gears completely submerged in oil.

Equalized water pressure on all sides prevents oil seepage.

Rubber bushed bearings throughout.

Joint at top of box eliminates seepage and gears are readily accessible.

Above features completely protect from sand, corrosion or galvanic action.

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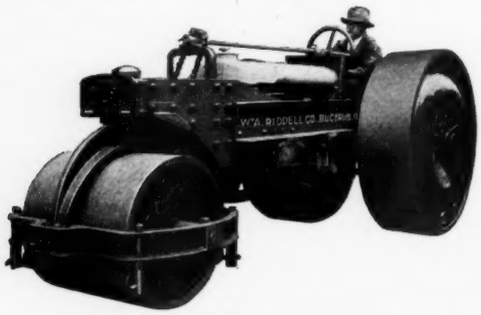
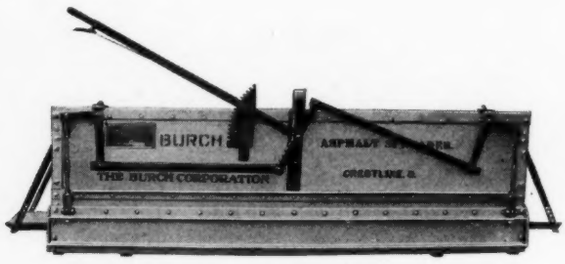
Salt Lake City, Utah.
Kansas City, Missouri.

and without making connections of any sort. The control levers are on the left front side of the machine where the operator has a full view of his work at all times and has complete control of his machine without leaving his seat.

Motor controls, including oil pressure gauge, are on an instrument board within view and reach of the operator. The house or cab is all steel construction, fully enclosed, and is provided with large door openings, and a window in the rear for light and ventilation. Electric dome and flood lights provide illumination from the storage battery for night operation.



RIDDELL ROAD ROLLER



BURCH ASPHALT SPREADER

AUSTIN PUBLIC SERVICE DITCHER

The Austin Machinery Corporation, Muskegon, Mich., has developed a small type ditcher to fill a particular demand by contractors, municipalities, and oil, gas, water and electric service companies for a heavier machine that will maintain ditch line and eliminate jumping.

It is claimed to be very fast and to have the ability to dig in any soil formation and to handle a big yardage of wet, sticky soil. A patented spring type bucket cleaner keeps buckets clean, and allows a full load at each round. It operates readily in confined space, will straddle pipes and make short turns.

Digging widths are 16 to 30 inches and digging depths 4 to 8 feet. Road traction speed is 1¼ to 1½ miles per hour and the digging speed 12 to 100 inches per minute, depending upon soil conditions, width and depth of trench. The overall length with boom extended is 23½ feet; without boom it is 15 feet; overall width is 6½ feet. It is powered with a Waukesha motor. The road pressure is 7½ pounds per square inch.

RIDDELL ROAD ROLLER

The W. A. Riddell Co., Bucyrus, O., has brought out a road roller designed to operate with Fordson and International tractors. It can be furnished ready to run or assembled on present power units. Motive power is transmitted to the rolls by a double width Diamond chain and cut steel sprockets on each rear roll, the chain being inclosed in dust proof cases and running in oil. These rollers are made in 6 to 10-ton sizes, with or without scarifier and leveler. Provision is made to add weight to both front and rear rolls. Speeds are from .95 to 1.9 miles per hour; reverse speed is 1.3 miles per hour. An adjustable planer or leveler can be attached ahead of the front roll. This has a 7-foot blade, is adjustable through worm gears by the roller operator, and is equipped with cushion springs.

The Warco roller is especially designed for highway, general contracting and park work.

FREDERICK DIAPHRAGM PUMPS

The Frederick Iron & Steel Co., Frederick, Md., have just brought out a line of diaphragm pumps. These are of extra heavy construction and are especially designed for handling water containing mud, sand, gravel and grit, and for handling other liquids. The design is simple, and the diaphragm is of highest quality rubber; the pump has rubber faced suction and discharge valves, properly weighted, and is arranged for either bottom or side suction. Portable outfits may be arranged for either engine or electric drive. Pumps are furnished in 2½, 3, and 4-inch sizes, with capacities of 1,800, 3,500 and 6,000 gallons per hour.

BURCH ASPHALT SPREADER

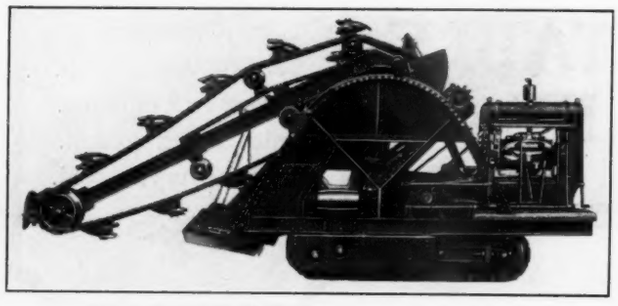
The Burch Corporation, Crestline, O., manufacture the Burch Asphalt Spreader, which it is claimed, will spread asphaltic material evenly over the subgrade and will save one-half the labor as compared to hand work. This spreader is attached to the truck carrying the asphalt mixture and the truck body is elevated as for dumping; the mixture slides down into the spreader, which can be adjusted in depth and width. The ends of the spreader are set at an angle of 30 degrees, giving a width to the spreader of about 6 feet, but the material can be spread in widths of 6, 7 or 8 feet and in depths of 1 to 6 inches. The front of the spreader is mounted on rollers causing it to move evenly over the subgrade.

NEW LEANING WHEEL GRADER DEVELOPMENTS

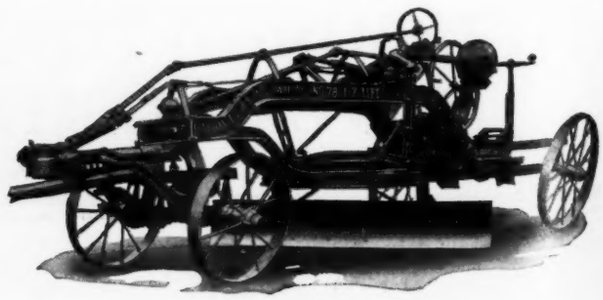
The Galion Iron Works & Mfg. Co., Galion, O., has announced two new Leaning Wheel E-Z Lift Graders, Nos. 77 and 78, and important improvements in its large size Nos. 10 and 12 E-Z Lift Leaning Wheel Graders. The two new graders are smaller, lighter machines of sizes for 7-foot and 8-foot moldboards. They have all of the features of the larger machines, including the Simplex pivotal frame adjustment and E-Z Lift gearing. Open E-Z springs are used, however, instead of the enclosed springs operating under compression as used in the larger sizes.

The enclosed lift springs have been placed down out of sight between the frame members. Some slight changes have been made in the placing of operating levers and cranks and minor improvements have been made in the steering assembly.

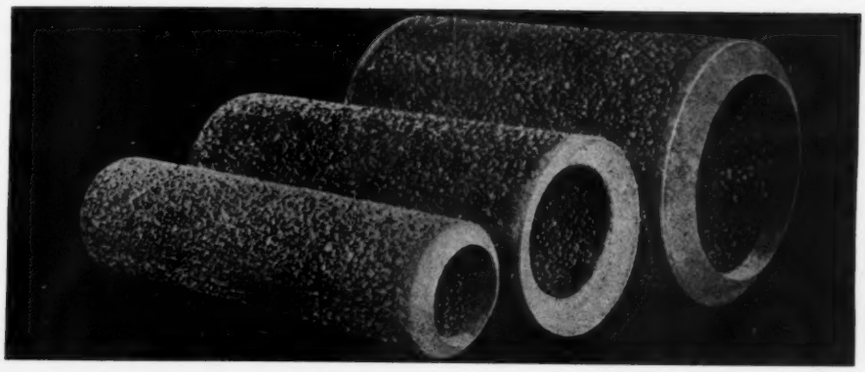
An important change is in the "bottom," as the blade and circle are called. The former cast steel full circle has been replaced by a semi-circle of railroad rail equally strong; and the use of the rail has permitted a reduction in weight which makes handling easy.



AUSTIN PUBLIC SERVICE DITCHER



NEW GALION GRADER



Good-Bye, Ol' "Necktie!!"

IN the past, every type of drain pipe had to have a "necktie" when it was put into the ground. That was because every pipe had solid walls.

The "necktie" was usually a strip of burlap laid over the open space between the lengths of each solid-wall drain pipe. It was placed there to keep out stone, dirt and other foreign matter. The lengths of pipe could not be brought close together. If they had been, no water would have drained into them at all. But, of course, the "necktie" quickly rotted away, thus allowing foreign matter to find its way into the pipe and clog it.

"Poroswall" knows no "neckties."

It never needs them. In fact, its lengths are brought close together, spigot-end into bell-end. This insures exact alignment and continuous flow-lines. Both advantages are possible only in "Poroswall," which, as its name implies, is **porous throughout its walls, having—**

"A Foot of Drainage for Every Foot of Wall."

"The Water Seeps in and Flows Through"

WALKER POROSWALL RAPID DRAIN PIPE

Walker Cement Products, Inc.
Little Ferry, N.J.
Plants at Little Ferry, N.J. & Baldwin, L.I., N.Y.

Send Coupon below for sample Pipe Section & Booklet

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.....

P. W.

RAWLS MOTOR-MOWER

The Rawls Manufacturing Co., Streator, Ill., has developed the Rawls motor-mower, which it is claimed, makes it possible to mow many areas where the cost of mowing by hand is prohibitive and where the purchase of a big mowing machine is not justified.

The Rawls Motor-Mower will go wherever a man can go, but does the work of fifteen or twenty men using scythes. The operator starts the engine, throws in the clutch, and the mower goes into action. It is guided as easily as a wheelbarrow, around boulders, trees, or stumps. It can be tilted for cutting up or down slopes, and pivots on its one wheel for turning sharp corners. It stands up under rough going, and will not get out of condition or stall when being driven over uneven ground or through thick and heavy vegetation.

The Motor-Mower is propelled by a direct-gear traction drive to the traction wheel, with the cutter bar connected direct to a power takeoff by means of pitman rod and balance crank pin. The cutter bar is of the heavy-duty type which is standard on Rawls Heavy-Duty Highway and Railway Mowers. The machine is especially suitable for cutting high grass and weeds, for work along highways which cannot be reached by regular mowers, and irrigation ditches and in public parks.

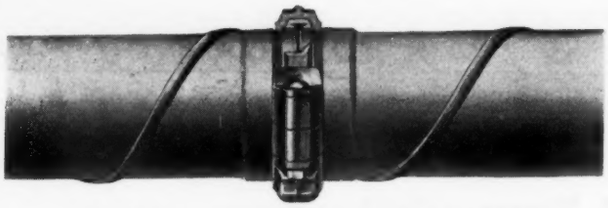
SELF-PROPELLED AIR COMPRESSORS

The Pontiac Tractor Co., Pontiac, Mich., manufactures a self-propelled air compressor of 124 cubic feet capacity. This outfit does not require a truck or tractor to take it from job to job. Power is furnished by a Fordson tractor unit, which is provided with a separate radiator which it is claimed maintains a temperature 60 to 70 degrees below machines cooling from the engine radiator, adding 15 per cent. to the efficiency. Light, rubber-tired wheels give good road speed. The speed is 700 revolutions per minute, and a maximum pressure of 100 pounds is attainable. Complete force feed lubrication is provided to all bearings, including piston pins.

NAYLOR PIPE AND VICTAULIC COUPLINGS

Naylor Spiral Pipe Co., Chicago, Ill., now manufactures Naylor Spiralweld Toncan iron pipe with grooved ends for Victaulic couplings in sizes from 4 to 12 inches in diameter. This is adapted for use where pipe is needed for handling air, water, steam, oil and gas, and where quick, easy installation is required. Because of the smooth inside and true diameter, frictional resistance is very small. It has the added advantage of light weight for ease and economy of handling, and yet, because of the welded seam, it is claimed that it will withstand as much pressure as standard weight wrought iron or steel pipe.

A special claim of Naylor Spiralweld Toncan iron pipe and Victaulic couplings is in the saving permitted in time, labor and maintenance. Unskilled labor may be used for installing, and a minimum of time is required for attaching Victaulic couplings; an exact alignment is not necessary; an additional saving is made in the cost of shipping because of the smaller dimensions of the couplings as compared with flanges, and the exceptionally light weight of the pipe; fittings and joints may be shipped separately to save space; lower maintenance cost, because the joints are leakproof even when subjected to severe shock or vibration; easy removal of any length of pipe in a line without disturbing the balance of the line.



NAYLOR PIPE AND VICTAULIC COUPLING

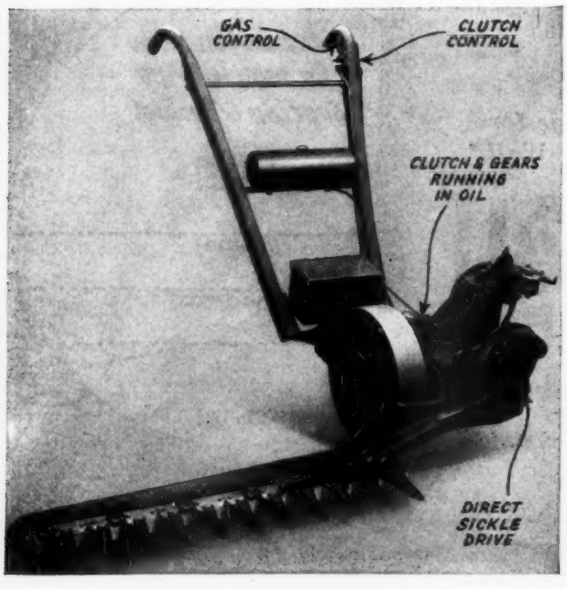
SECO PARKOVENS

The Sanitary Equipment Co., North Kansas City, Mo., has developed "Parkoven," a device suitable for outdoor cooking in parks and camps, with which is combined an incinerator designed to care for park and camp wastes. Primarily, "Parkoven" is designed for cooking in outdoor recreational parks. It carries an all cast-iron top of 5/8-inch plate. The tops are sectional and the No. 50-B unit carries two griddle plates and two eye plates of four eyes each. The cooking oven combustion chamber is so constructed that the cooking plates absorb a very high percentage of heat. There is a smoke stack, in which is incorporated a No. 50 incinerator. Hot gases from the combustion chamber pass through into the incinerator chamber, dry out the refuse contained therein, and ignite it.

A safety factor is provided, the danger to users, when this equipment is employed, being practically eliminated, as is the possibility of forest fires.

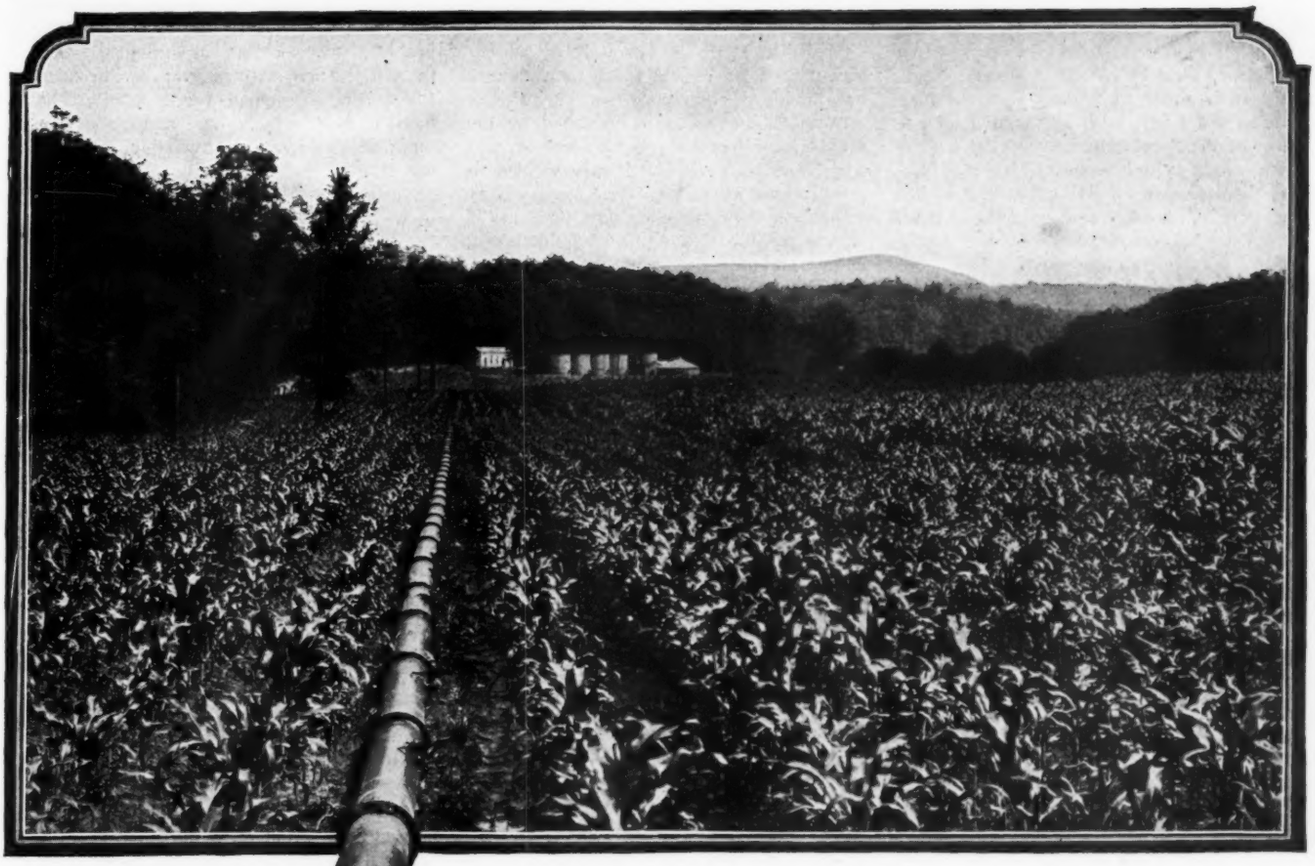
INDIANA ROAD BUILDERS

Indiana Truck Corporation, Marion, Ind., has added to its line two new 3-ton trucks. These new models are designed as two 7-bag batch road builders, and are furnished with 72-cubic foot dump bodies, the right capacity for two 7-bag batches, 1, 2, 3 mix; two 6-bag batches, 1, 2, 4 mix; or two 6-bag batches, 1, 2, 3½ mix, when the cement is carried in sacks on top of the sand and stone. The patented "Tors-Elim" three-point suspension mounting of motor



RAWLS MOTOR-MOWER

SECO PARKOVENS



for high pressures

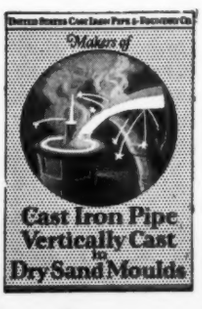
use deLavaud Centrifugal Cast Iron Pipe

THE high tensile strength of deLavaud centrifugally cast Cast Iron Pipe makes it ideal for pressure lines.

Due to the density of the iron cast—by the deLavaud centrifugal method—there is no seepage.

The line illustrated here was tested at 260 lbs. pressure and is subjected daily to a pressure of 230 lbs. per sq. in.

Write for special literature covering the manufacture, specifications and use of deLavaud centrifugal pipe.



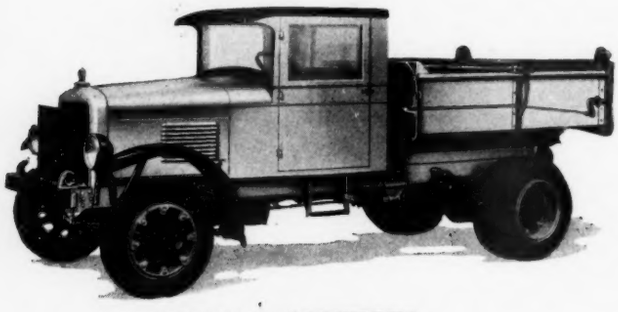
United States Cast Iron Pipe and Foundry Company

General Offices:
Burlington, New Jersey

SALES OFFICES

Philadelphia: 1421 Chestnut St.
Chicago: 122 So. Michigan Blvd.
Birmingham: 1st Ave. & 20th St.
Buffalo: 957 East Ferry Street
Cleveland: 1150 East 26th Street
New York: 71 Broadway
San Francisco: 3rd & Market Sts.
Pittsburgh: 6th & Smithfield Sts.
Dallas: Akard & Commerce Sts.
Kansas City: 13th & Locust Sts.
Minneapolis: 6th St. & Hennepin Ave.

and radiator units, exclusive with Indiana Trucks, is used on these two models. Model 127-A Indiana Road Builder is powered with a four-cylinder engine, 4¼ x 5¾, with a piston displacement of 326.3 cubic inches; Model 627-A, with a six-cylinder engine, 3¾ x 5, piston displacement of 331 cubic inches, developing 67 horsepower at 2000 R.P.M. The transmission is five speed unit power plant, selective sliding gear design, five speeds forward, two in reverse. A speed of 25 miles per hour may be obtained in direct from the 127A model, and 30 miles per hour in the over-drive, while the Model 627A is capable of 30 miles per hour in direct and 35 miles per hour in the over-drive. Tires are pneumatic cord, 32 x 6 front and 34 x 7 dual rear. The steering gear is of the cam and lever type. The frame is of heat treated pressed steel construction.



INDIANA ROADBUILDER

NEW POWER SAWYER

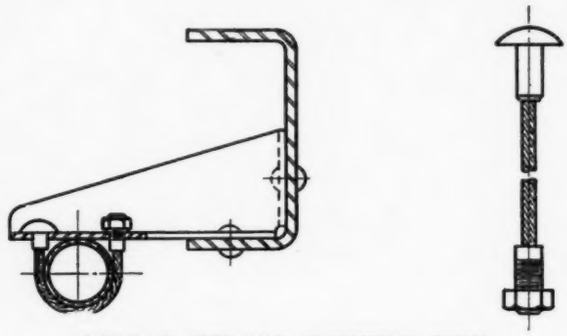
The Marsh-Capron Co., Chicago, Ill., has recently placed on the market a traveling saw arbor which will do double mitering, bevel ripping, rabbeting, or any kind of sawing in addition to ordinary cross-cutting and ripping. This unit has been so designed that full sawing force is applied evenly to the wood from the start to the finish of the cut. Any kind of a cut that can be made by hand saw or by any sawrig can be made with the Power Sawyer. It has a tilting table top, adjustable saw arbor, safety guards, sawdust chute, and 14-inch cross-cut and rip saws as standard equipment; 12-inch or 16-inch saws can be used if desired.

Eight to 10 h. p. Leroi or Novo engines, or 5 or 7½ h. p. electric motors are standard equipment for the Power Sawyer. The engine is mounted on the same frame members as the sawrig, and the whole frame is electrically welded to produce an extremely rigid, heavy-duty frame. A floor space of only 36 in. x 77 in. is required for the whole outfit, engine and all.

NEW FLEXIBLE BOLT

The American Cable Co., Chicago, Ill., has recently perfected the Tru-Lay-Tru-Loc flexible bolt which makes possible the attachment of fittings by the processing method that compels the fitting to become an integral part of the rope. These new bolts may be used in any place where rigid U bolts are impracticable, such as auxiliary hangers for power shafts, suspension brackets for overhead steam or water piping, shackle bolts for temporary wall boxes, tanks, etc., for scaffolding and tackle, on various parts of machinery, and in other places where semi-flexible connections are necessary.

The principle on which the new flexible bolt rests is the preformed type of wire rope. Preforming the wires and strands to the exact helical shape they must assume in the completed rope results in a cable that does not require seizing, but may be cut like a rod. This type of rope permits a close fitting attachment to be slipped over the unseized end of the rope and to be processed so that the steel of the fitting cold flows into the interstices of the rope and thus becomes practically an integral part thereof. Such fittings can be threaded for a nut or capped for a head. The flexible bolt which has resulted from these developments is available in varying lengths.

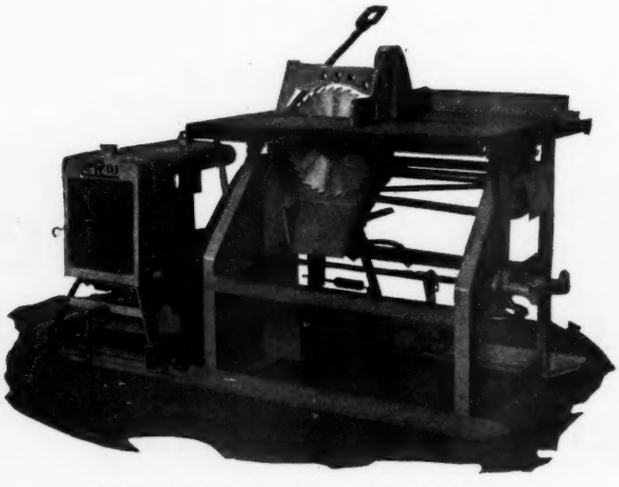


TRU-LAY TRU-LOC FLEXIBLE BOLT

NEW LITTLEFORD TAR AND ASPHALT HEATER

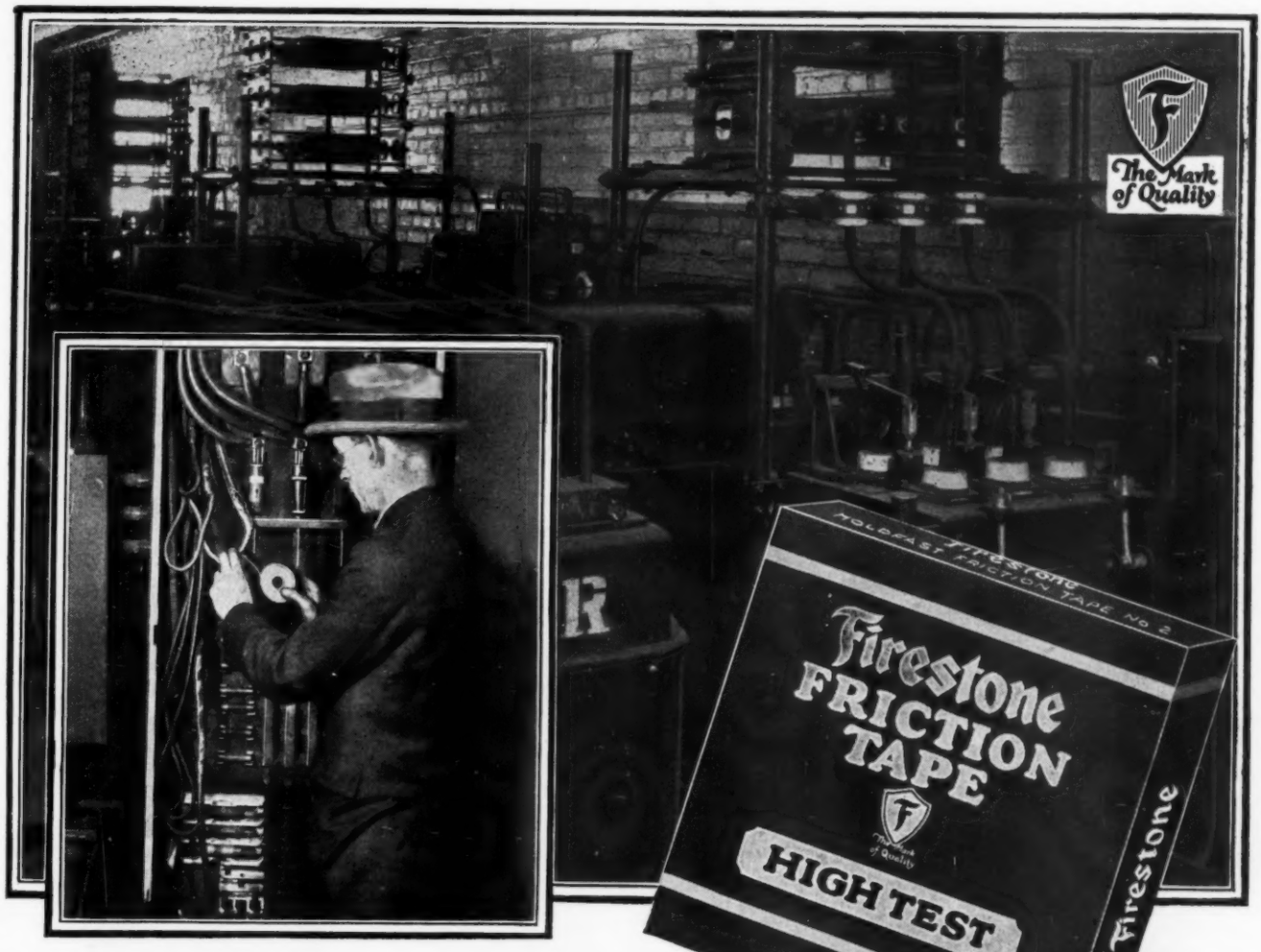
Littleford Bros., Cincinnati, O., has recently added a new large capacity tar and asphalt heater for highway maintenance work. It is an exclusive oil burning model and has a capacity of 300 gallons. It is of especial value, it is claimed, when there are several scattered repair jobs to be taken care of quickly. The kettle can be loaded before starting for the first job and then moved rapidly from job to job without the necessity of constantly recharging, as must be done with smaller kettles. It is a handy piece of equipment for county and state highway departments as it can be used on both large and small jobs. It can be used where large quantities of material are required, such as skin patching and shoulder work, also on small jobs such as repairing holes, filling cracks and expansion joints, etc.

It is claimed to be a very fast heating outfit, heat being supplied by two Littleford torch burners. Sil-O-Cel insulation in bottom of combustion chamber prevents heat loss and greatly increases the efficiency of the burners. The rear section of cover is hinged and when closed forms a warming hood under which barrels may be drained.



MARSH-CAPRON PORTABLE SAWYER

NEW LITTLEFORD HEATER



The SURE WAY

To Protect Expensive Equipment—

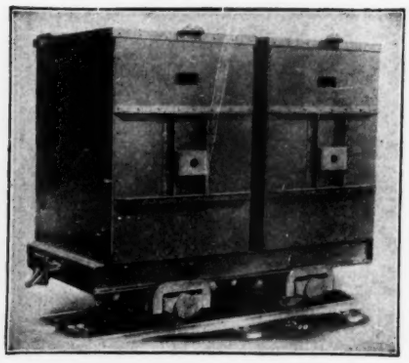
Keep out moisture, dirt, oil, grease and extremes of temperature—eliminate leakage—get the full benefits of your investment every hour of every day in the year—by insulating with Firestone Friction Tape. Here is a tape that meets the most rigid specifications—more exacting than the requirements of the United States Government and the Society for Testing Materials. The unusually high dielectric strength, the lasting adhesiveness of the sulphur-free rubber, the age-resisting properties, high tensile strength, absence of raveling and uniform quality have brought Firestone Friction Tape into wide use among leading electrical equipment manufacturers, public utilities, power houses, contractors, electricians and mechanics. Sold direct to manufacturers and jobbers—in bulk or in attractive display cartons for resale to the trade. Write for prices and quantity discounts.

Firestone
FRICTION TAPE

AMERICANS SHOULD PRODUCE THEIR OWN RUBBER . . Harvey S. Firestone

LAKEWOOD BATCH BOX CAR

The Lakewood Engineering Co., Cleveland, Ohio, has announced a new batch box car and batch box for road work. The car, No. 255-B, is designed with a carrying capacity amply large enough to handle two 48-cubic foot batch boxes. The frame is of 6-inch ship channel, strongly braced and reinforced. Axles are alloy steel, heat treated, having a journal 2½ inches by 6 inches. Either



LAKEWOOD BATCH BOX CAR

the Lakewood Cage Roller Bearing, or Hyatt Bearings, can be furnished. Complete spring draft rigging is standard equipment. Wheels are of cast steel, 14 inches in diameter.

The new type of Lakewood batch box incorporates the feature of adjustable trunnions, making it possible to alter the tipping axis of the box to allow for variations in sizes of batches that may be encountered on different jobs. The growing practice of weighing materials has made this feature of greater importance than ever before. Another feature is the use of a chain in the bottom of the cement compartment which helps clean the cement from the compartment when the box is dumped.

The 48-cubic foot size of box seems to be preferred by most contractors, as this has ample capacity to handle practically any batch now being used in the 27-E Pavers. However, these boxes are made in 41 and 45 cubic foot capacities to meet any other requirements of mixing or paver capacity.

ARCADIA TRAILERS AND DUMP BODIES

The Arcadia Truck Body Corp., Newark, N. Y., manufactures heavy duty drop frame trailers of 3½ and 4 yards water level capacity, which are especially designed for garbage and refuse removal work, and also a wide line of truck bodies. The drop frame trailers have a low loading edge and are designed to dump to the side. The dump bodies are made in all sizes from 1½ to 4 yards capacity for 1 to 5-ton trucks of any standard make and to operate with all makes of mechanical, hydraulic or hand hoists. They are of white oak, white ash, hickory and steel. The "Subway Special," which is used on New York subway work, is an extra strong body of 4 yards capacity especially designed to withstand the handling of rock.

OHMER RECORDOGRAPH

The Ohmer Fare Register Co., Dayton, O., manufacture the Ohmer Recordograph, which is a simple and compact machine which records automatically the details of the operation of motor vehicles. It tells at a glance the speed attained by the vehicle at any moment of the day, how many stops were made, and how long, and the total mileage covered. The record is made on a continuous indelible line on a specifically prepared tape. The tape is "36 hours long" divided by means of vertical lines into hourly periods. The hours are again subdivided into five minute periods.

The distance traveled is shown by horizontal lines, each line representing one-fourth of a mile. When the vehicle moves, the marker travels obliquely over the tape. When the pencil line extends from the bottom to the top or from the top to the bottom of the tape, a total distance of two miles has been covered. The pencil lines are oblique when the vehicle is moving and horizontal when the vehicle is standing still.

Thus, a horizontal line denotes that the vehicle remains stationary five minutes for each square through which it travels. Idle time can be computed in total and the exact time of the day that the vehicle remained standing can be ascertained. The faster the vehicle travels, the more oblique are the pencil lines. The Recordograf is attached to the instrument board or any other convenient place, and is driven from the transmission, making its operation positive and accurate. The records it makes are under lock and key, and cannot be reached or tampered with.

This graphic information allows positive control of costs and reduction of expenses. Unnecessary overtime will be reduced; the average speed of the vehicle can be increased if necessary. Overspeed, conducive to accidents, and excessive repair bills can be stopped. Drivers' efficiency can be determined and operating costs can be cut down.

OHMER RECORDOGRAPH

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the Act of Congress of August 24, 1912, of Public Works, published monthly at New York, N. Y., for April 1st, 1928.

State of New York, County of New York, ss.: Before me, a Notary Public in and for the state and county aforesaid, personally appeared James T. Morris, who, having been duly sworn according to law, deposes and says that he is the business manager of Public Works, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and, if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse side of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business editor and business manager are:
Publisher—Public Works Journal Corporation, 243 West 39th Street, New York, N. Y.
Editor—A. Prescott Folwell, Montclair, N. J.
Managing Editor—A. Prescott Folwell, Montclair, N. J.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total of stock,
Public Works Journal Corporation, 243 West 39th Street, New York, N. Y.
Sumner W. Hume, 243 West 39th Street, New York, N. Y.
James T. Morris, White Plains, N. Y.
A. Prescott Folwell, Montclair, N. J.
Contracting Pub. Co., New York, N. Y.
Stockholders of Contracting Publishing Co.:
H. F. Pomeroy, 33 W. 42nd St., New York, N. Y.
J. R. Breuchaud, 342 Madison Ave., N. Y. City.
H. F. Hackerdorn, Consumers Bldg., Chicago, Ill.
Frank W. Skinner, 20 Vesey Street, N. Y. City.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are:
Swetland Publishing Company, 239 West 39th Street, New York, N. Y.

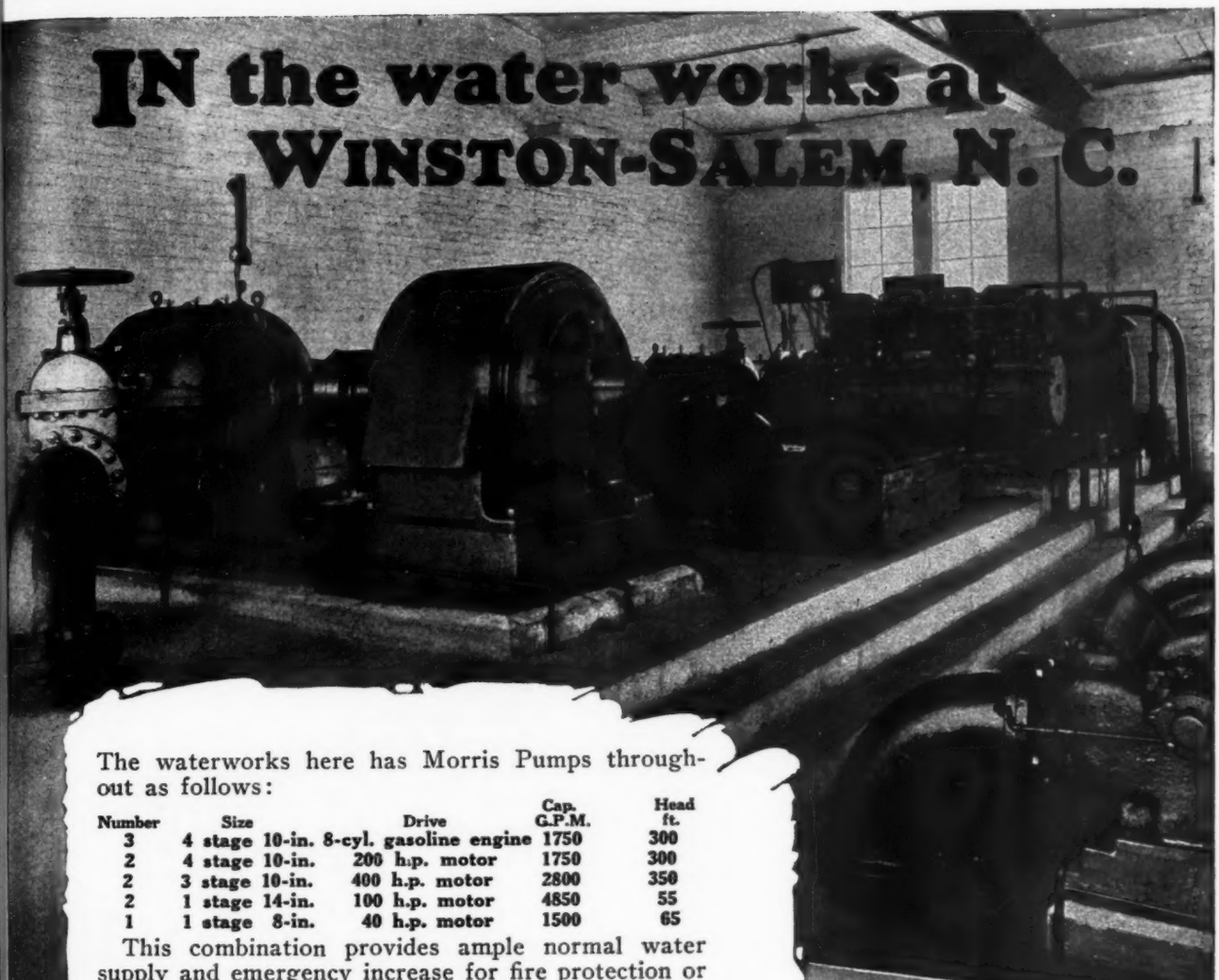
4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also, that the said two paragraphs contain statements embracing affiant's knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest, direct or indirect, in the said stock, bonds or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only).

JAMES T. MORRIS, Business Manager.

Sworn to and subscribed before me this 29th day of March, 1928.
(Seal)
R. CROXTON MORRIS,
Notary Public, Westchester County, N. Y.,
Cert. filed in N. Y. Co. No. 1143—Reg. No. 9031-A.
(Commission expires March 30, 1929)

IN the water works at WINSTON-SALEM, N. C.



The waterworks here has Morris Pumps throughout as follows:

Number	Size	Drive	Cap. G.P.M.	Head ft.
3	4 stage 10-in.	8-cyl. gasoline engine	1750	300
2	4 stage 10-in.	200 h.p. motor	1750	300
2	3 stage 10-in.	400 h.p. motor	2800	350
2	1 stage 14-in.	100 h.p. motor	4850	55
1	1 stage 8-in.	40 h.p. motor	1500	65

This combination provides ample normal water supply and emergency increase for fire protection or unexpected peak without overtaxing the electric power.

Dividing the pumping power into a number of independently operated units, as above, permits a desirable choice at any and all times with constant high economy.

Morris Pumps offer a wide selection to meet any water supply requirement and Morris Engineers cooperate with plant owner, manager or consulting engineer to assure a well balanced plant of high economy. Write for Bulletin 122.

MORRIS MACHINE WORKS
Baldwinsville, N. Y.

Originators of Centrifugal Pumps, both Single and Multi-Stage, and builders for practically all purposes since 1864

Branch Offices:—New York, 26 Cortlandt Street; Philadelphia, Witherspoon Building; Cleveland, 1367 E. Sixth St.; Chicago, 217 N. Jefferson Street; Boston, 79 Milk Street; Pittsburgh, 320 Second Avenue; Detroit, Penobscot Building.

MORRIS
CENTRIFUGAL PUMPS

SPECIAL GARBAGE BODIES

The Heil Co., Milwaukee, Wisc., has recently developed two truck bodies designed for handling garbage. The equipment used in Newton, Mass., has a special watertight tail gate construction, which also provides support for rods to carry tarpaulin covers. The loads may be heavily crowned and yet not touch the tarpaulins because these can be drawn tight and fastened on the body cleats. The tailgate construction makes the body watertight.

HEIL GARBAGE BODY USED IN SYRACUSE

The equipment used in Syracuse has many valuable and labor-saving features. The duck-tail design of the rear end of the body provides water-tight construction. The upper half of the sides are hinged to facililate hand loading and dumping of cans. A step is provided which tilts up out of the way when in transit.

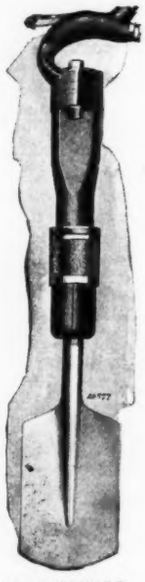
All this equipment is provided with Heil hoisting equipment.

INGERSOLL-RAND "73" PNEUMATIC DIGGER

The Ingersoll-Rand Company, New York, has developed a new pneumatic digger to meet the demand for a more powerful lightweight tool. This new digger, size 73, is claimed to have more power than any other tool of equal weight.

Its construction is entirely different from that of other diggers. A self-seating plate valve of the "flapper-type" is used which gives a smooth and very positive action, and is so constructed that it actually seats tighter with use. The light weight, small travel, and cushioned action of the valve make wear negligible. The tool-retaining device is also of a new construction; designed, first, to enclose completely the lower end of the barrel, thus keeping dirt from working up into it; second, to support the lower portion of the shank of the blade; and third, to make possible easy assembly and removal of the rubber buffer and blade. Two types of handles are furnished; an open-type outside trigger handle, which is standard, or a closed-type inside trigger handle. The handle is bolted to the barrel giving a very secure construction and one which can be easily disassembled and assembled.

This new tool has been found particularly suited for tunnelling in clay and for similar work. The extra power combined with ease of handling make possible an increase rate of work.



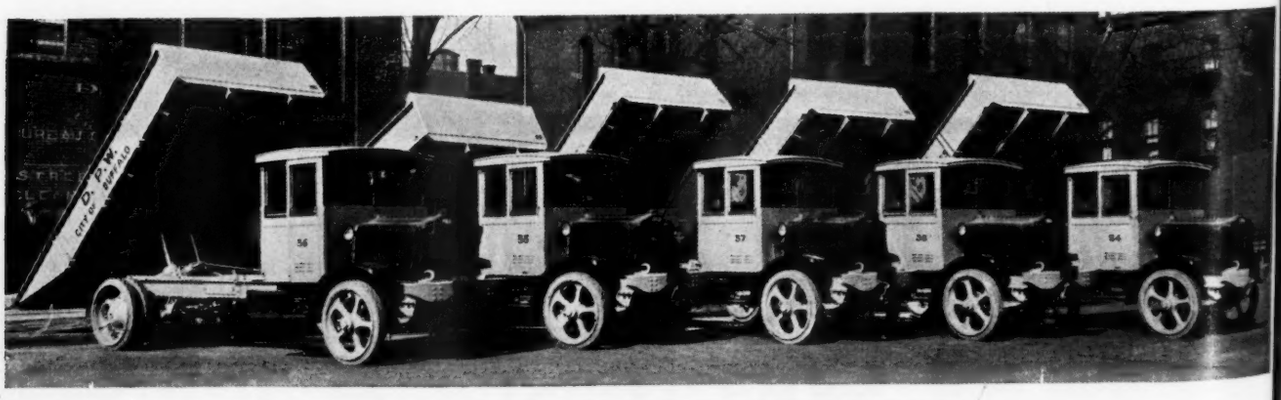
INGERSOLL-RAND "73"

ALUMINITE STREET MARKERS

The Standard Mfg. Co., Cedar Falls, Ia., manufacturers a wide variety of street markers. The accompanying illustration shows a much used style. Any length of plate can be used in combination and because of the patented adjustment feature the plates can be set at any angle to conform to any angle of street.

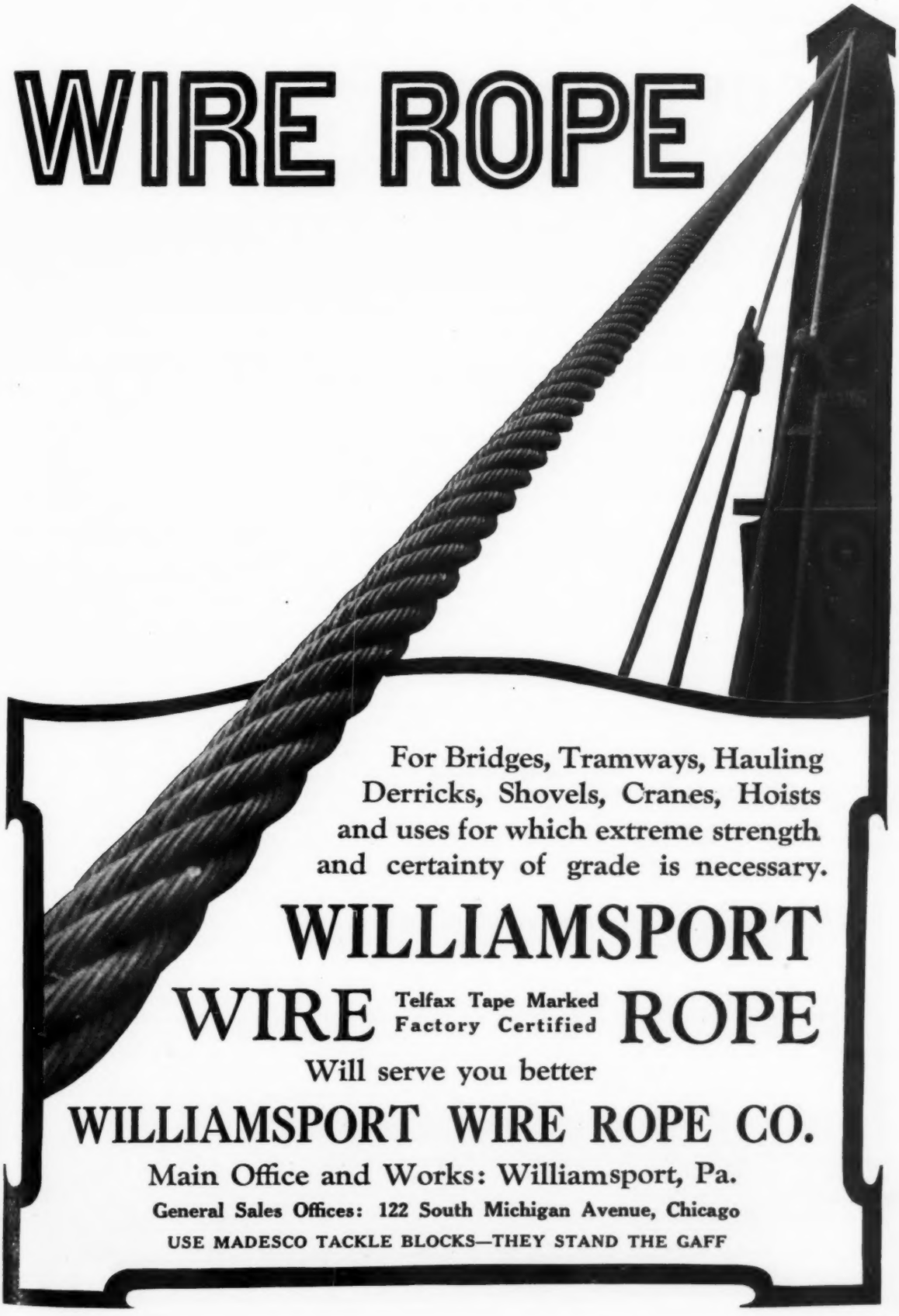
Such markers should be installed 8 ft. above ground to give an unobstructed view and can be mounted on any type of post, but a heavy galvanized steel post set in concrete is recommended inasmuch as these signs are permanent and are worthy of a substantial mounting in keeping with the quality of sign itself. Cast aluminum caps for attaching signs to tubular posts or brackets are furnished with the signs.

ALUMINITE STREET SIGN



BEIL GARBAGE BODIES USED BY CITY OF BUFFALO

WIRE ROPE



For Bridges, Tramways, Hauling Derricks, Shovels, Cranes, Hoists and uses for which extreme strength and certainty of grade is necessary.

WILLIAMSPORT WIRE ROPE

Telfax Tape Marked
Factory Certified

Will serve you better

WILLIAMSPORT WIRE ROPE CO.

Main Office and Works: Williamsport, Pa.

General Sales Offices: 122 South Michigan Avenue, Chicago

USE MADESCO TACKLE BLOCKS—THEY STAND THE GAFF

McCLOSKEY
BOMB SHELL
TORCHES

The Best and Cheapest Danger Signal Made

Why protect your job with a piece of tin when you can get a real danger signal made of heavy steel — indestructible—efficient—dependable—economical?

Used by states, cities and contractors everywhere.

If your dealer cannot supply you write for circular.

Patented in U. S. A. and Canada.

McCLOSKEY TORCH CO.
Spitzer Bldg., Toledo, Ohio

INDUSTRIAL NOTES

The Wood Hydraulic Hoist and Body Co., Detroit, Mich., has opened a New York City Branch office which is in charge of A. B. Weston.

The Carbic acetylene floodlight, the Carbic acetylene generator, and other Carbic equipment utilizing acetylene, formerly sold by the Carbic Manufacturing Company, Duluth, Minn., will in the future be distributed exclusively by the Oxweld Actylene Company, 30 East 42nd Street, New York.

The processed carbide in cake form, sold under the trade-mark Carbic, for Carbic lights and generators, will be distributed exclusively by the Union Carbide Sales Company, New York, through its nationwide chain of warehouses.

Dr. George E. Ladd, economic geologist of the U. S. Bureau of Public Roads, has been appointed consulting geologist by the Armco Culvert Mfrs. Ass'n. Dr. Ladd has had a long experience in university teaching and administration and has been recognized as a specialist in the field of landslide control. By the present appointment, the services of Dr. Ladd will be available to public and private officials who are confronted with difficult and unusual landslide, subsidence, drainage and similar problems. His headquarters will be at Middletown, O.

Edgar S. Ross, recently resigned from Mellon Institute of Industrial Research, Pittsburgh, Pa., is now manager of research and development, Headley Good Roads Company, Philadelphia, Pa., manufacturers of emulsified asphalts. In this work his full time will be devoted to promotional and development work incident to the practical applications of these products.

The Chausse Oil Burner Company, Elkhart, Indiana, reports the sale of 2 Chausse Portable Asphalt Plants to the District of Columbia for use in maintenance work on Washington streets. With these machines were shipped 3 Surface Heaters. Another asphalt plant has been shipped to the City of Little Rock, Arkansas. Shipments of Tool and Surface Heaters and Tar Kettles to municipal and state highway departments, this spring, have exceeded the total annual shipments of some previous years. This is an indication of the activity in maintenance work on state and city roads and streets.

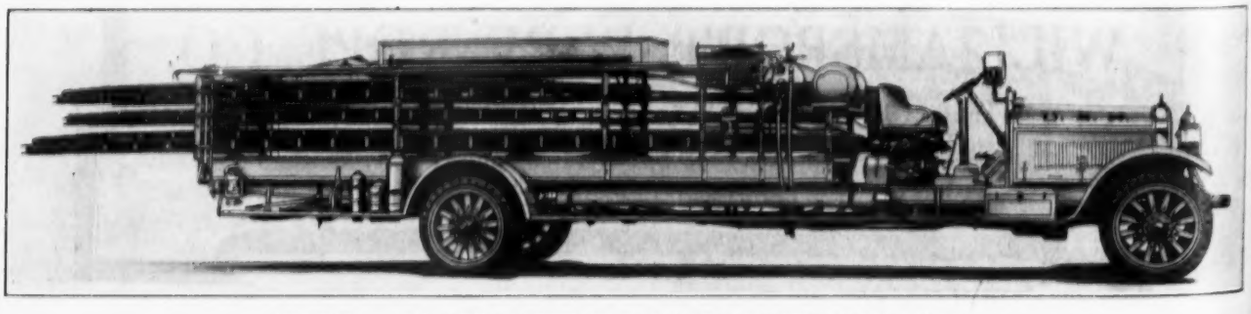
The "Hunt Process" of curing concrete pavements is being extensively used in California and in other western states. In the city of Los Angeles 11,542,348 square feet of pavement completed or under construction was or is being treated with that process. Outside of Los Angeles, 7,867,948 square feet have been treated. Everlasting Paint and Sales Company, Board of Trade Building, Los Angeles, owners of the "Hunt Process," state that their process has been approved by the Bureau of Public Roads for use on Federal Aid roads. The company has for free distribution a diagram showing comparisons between "Hunt Process" and water cured concrete.

The Servicised Products Corporation, Chicago, has doubled its plant capacity over 1927 and has acquired property at New Orleans for the manufacture and distribution of expansion joint at that point. It was recently successful in securing the contract with Wayne County, Michigan, for road work for 1928, furnishing 25 carloads of expansion joint. Recent products are an expansion joint with felt sides and a matted felt fibre core, and a cork seal joint which comprises 75 per cent. asphalt, 18 per cent. ground cork and 7 per cent. fibre. This is primarily for buildings and where high resilliency is required in an expansion joint. Servicised is also introducing a Gray crown joint for municipalities.

At the annual meeting of the officers and directors of the Orton Crane & Shovel Co., of Chicago, recently held at the company's manufacturing plant at Huntington, Ind., P. A. Orton, Sr., was re-elected president and general manager, and Harry Shaffer was re-elected treasurer. P. A. Orton, Jr., formerly in charge of sales in the Chicago territory, was elected vice-president and sales manager, and Herbert Mertz was made vice-president in charge of sales in the New York territory. Alex Orton, works manager at Huntington, Ind.; C. C. Case, of Chicago, and J. L. Kenower, of Huntington, also were elected members of the board of directors.

Chas. E. Stone since 1924 Vice-President of the Interstate Drop Forge Company, Milwaukee, manufacturers of drop forgings, has been elected President, succeeding C. R. Messinger who is a member of the board of directors and President of the Chain Belt Company. Lamar S. Peregoy was elected vice-president. C. C. Bremer and J. C. Merker were re-elected treasurer and secretary respectively.

Appointment of three vice-presidents of the Truscon Steel Co. of Youngstown, Ohio, has been announced by Julius Kahn, president of the company. C. I. Auten, who began as an engineer with Truscon seventeen years ago, has been named vice-president in charge of sales in the standard building division of the firm. Under his charge will be sales of structural steel, steeldeck roofing and transmission structures. M. T. Clark has been made vice-president in charge of sales of the steel window division, with which he has been identified for the last nine years. C. D. Loveland, formerly manager of the Pittsburgh district of the Truscon organization has been made vice-president with headquarters at Newark, N. J. He will be in charge of Truscon distribution in that state.



PIRSCH FIRE APPARATUS FOR MARE ISLAND NAVY YARD